Vol. II MARCH 1931 No. 1

CHILD DEVELOPMENT

This number contains reports of methods of relating diverse data from measurements of children; of studies of the influence of race, sex, and disease upon skeletal maturation; of the relative influence of eye and hand training upon reproduction of designs; and of effects of training upon creative tendencies in young children.

PUBLISHED QUARTERLY BY THE WILLIAMS & WILKINS COMPANY
MOUNT ROYAL AND GUILFORD AVENUES, BALTIMORE, U. S. A.

Made in United States of America

CHILD DEVELOPMENT

Information for Contributors and Subscribers

Correspondence relating to articles and papers for publication should be sent to Dr. Buford Johnson, Psychology Department of The Johns Hopkins University, Homewood, Baltimore, Maryland.

Articles submitted should be typed and double spaced and original copy only submitted. The journal accepts articles with the understanding that they are subject to editorial revision. All articles are subject to copyright and may not be used without authority elsewhere. Articles not used will be returned only if return postage is sent.

Twenty-five reprints without covers of articles will be furnished gratis to the author or will be divided among the authors if there are more than one. A table showing the cost of additional reprints with an order slip is sent with proof. Reprints are made only when reprint order slip is returned to us.

Correspondence concerning business matters should be sent to The Williams & Wilkins Company, Mt. Royal and Guilford Avenues, Baltimore, Maryland.

CHILD DEVELOPMENT will be issued quarterly in March, June, September, and December of each year. The first number was published in March, 1930. The volumes will consist of about 400 pages. A volume will be issued within the year for which it is current.

The Subscription Price: $5.00 per volume in the United States and countries within the postal union: $5.50 in countries outside the postal union. Prices are net, postpaid.

Claims for copies lost in the mail must be received within 30 days (90 days foreign) after the date of issue. Changes of address must be received at least two weeks in advance of issue.

New subscriptions and renewals are entered to begin with the first issue of the current volume. Should any issue of the current volume be out of print at the time the subscription order is received, the pro rata value of such numbers will be credited to the next volume and the renewal invoice therefore adjusted accordingly.

Subscriptions should be renewed promptly. To avoid a break in your series subscriptions should be renewed promptly. The publishers cannot guarantee to supply back issues on belated renewals. Whenever possible back numbers will be supplied at $1.50 per copy.

AGENTS

For Argentina and Uruguay: Beutelspacher y Cia, Sarmiento 815, Buenos Aires.

For Australia: Angus & Robertson, Limited, 89–95 Castlereagh Street, Sydney.

For Belgium: Henri Lamertin, 58 Rue Coudenberg, Bruxelles.

For the British Empire, except Australia and Canada: Baillière, Tindall & Cox, 8 Henrietta St. Covent Garden, W C. 2, London, England.

For Canada: Wm. Dawson & Sons, Ltd., 91 Queen Street East, Toronto.

For China: Commercial Press Ltd., Paoshan Road, Shanghai, China.

For Denmark: H. Hagerup's Boghandel, Gothersgade 30, Kjöbenhavn.

For France: Émile Bougault, 48 Rue des Ecoles, Paris.

For Germany: B. Westermann Co., Inc., Zimmerstrasse 35–41, Berlin SW-68, Germany.

For Holland: Scheltema & Holkema, Rokin 74–76, Amsterdam.

For Japan and Korea: Maruzen Company, Ltd. (Maruzen-Kabushiki-Kaisha), 6 Nihonbashi Tori-Nichome, Tokyo; Fukuoka, Osaka, Kyoto, and Sendai, Japan.

For Spain: Ruiz Hermanos, Plaza de Santa Ana, 13, Madrid.

THE WILLIAMS & WILKINS COMPANY

Publishers of Scientific Books and Periodicals

BALTIMORE, U. S. A.

PUBLISHERS OF: *Medicine, Journal of Urology, Journal of Pharmacology and Experimental Therapeutics, American Journal of Tropical Medicine, Journal of Immunology, Journal of Industrial Hygiene, Quarterly Review of Biology, Journal of Bacteriology, Annals of the Pickett-Thompson Research Laboratory, Journal of Biological Chemistry, Chemical Reviews, Journal of Dairy Science, Soil Science, Social Forces, Personnel Journal, Journal of Comparative Psychology, Mental Measurement Monographs, Studies in Psychology and Psychiatry, Occupational Therapy and Rehabilitation, Child Development, Journal of Aviation Medicine, Journal of Clinical Investigation, The American Journal of Clinical Pathology.*

Entered as second-class matter May 9, 1930, at the post office at Baltimore, Maryland, under the act of March 3, 1879

COPYRIGHT 1931, THE WILLIAMS & WILKINS COMPANY

CHILD DEVELOPMENT

EDITORIAL BOARD

BUFORD JOHNSON, *Editor-in-Chief*
Director of the Child Institute of the Psychological Laboratory, and Professor of Psychology of The Johns Hopkins University

ASSOCIATE EDITORS

JOHN E. ANDERSON
Director of the Institute of Child Welfare and Professor of Psychology of The University of Minnesota

E. V. McCOLLUM
Professor of Biochemistry, School of Hygiene and Public Health, The Johns Hopkins University

EDWARDS A. PARK
Professor of Pediatrics, The Johns Hopkins University Medical School

MANDEL SHERMAN
Director of Research, Washington Child Research Center, Washington, D. C.

T. WINGATE TODD
Professor of Anatomy, Western Reserve University Medical School

VOLUME II

MARCH, 1931 to DECEMBER, 1931

BALTIMORE
THE WILLIAMS & WILKINS COMPANY
1931

NEW YORK
PUBLIC
LIBRARY

THE NEW YORK
PUBLIC LIBRARY
966985A
ASTOR, LENOX AND
TILDEN FOUNDATIONS
R 1938 L

NEW YORK
PUBLIC
LIBRARY

A Comparative Study of Measurements and Qualitative Ratings of Nursery School Children

ELISE HATT

INTRODUCTION

THIS paper reports the results of a study undertaken at the Merrill-Palmer School[1] with the purpose of showing the efficiency of a profile based upon percentiles, the Biogram, in indicating the relative superiority or inferiority of individual nursery school children. In studying this point, a comparative study was made of the Biograms of two groups of nursery school children, one group considered by adults observing them in the nursery school to be "most desirable," and the other group "least desirable," from an all-round point of view, in order to determine (1) what traits best differentiate the two groups of children and (2) the relative importance of the different traits in determining what is regarded as "desirability" and "undesirability." These terms were considered more appropriate than "superiority" and "inferiority" to indicate the differences among children who as a group are superior. They are used throughout in a relative sense. The final value of such a study is, of course, to find out whether it is possible to integrate many diverse data—mental, physical, and social—in such a way that the cumbersome and time-consuming qualitative summaries concerning the child can be replaced in part by a graphic summary which is at once more simple and more efficient in conveying an impression of the child's status in all the traits measured. Finally, there is a short discussion of a few individual children whose ranks on the Biogram differed from those given them by the adult observers; these cases were studied to determine what measures may be added to the present quantitative records to eliminate this discrepancy between the subjective impression of the child and his quantitative record.

[1] The author is happy to acknowledge her indebtedness to Dr. H. H. Remmers, whose study *A Diagnostic and Remedial Study of Potentially and Actually Failing Students at Purdue University* was helpful in the present analysis; and to the staff of the Merrill-Palmer School, especially to Miss Mary E. Sweeny and Dr. Rachel Stutsman, for their advice during the course of the study, Miss Leone E. Chesire, whose statistical work in compiling the percentile tables of *The Merrill-Palmer Standards of Physical and Mental Growth* is the indispensable basis for the present paper, and Miss Dorothy Tyler, who prepared the manuscript for publication.

BACKGROUNDS OF THE STUDY

The integration of the quantitative data on the Merrill-Palmer nursery school children has for some time

presented a problem. The number of measurements taken has increased until now, after seven years of record-taking (1922 to 1929), over fifty different kinds are made. Before a method of synthesizing the data had been developed, the reports upon individual children included the monthly record of weight and height sent to the parents; the weekly summary of certain factors distributed to the staff; and a complete narrative report of the child, based upon all the records, which is sent to the parents at the time of the child's withdrawal from the nursery school, but is not available when it is most important to the School—while the child is still under its care. Aside from these reports, there have been occasional elaborate analyses of all the data on certain children for special use at the School or for presentation before professional groups. These analyses, however, had disadvantages: They were unwieldy; they could be issued only occasionally because of the time required to make them; they included only a few children; and since the data were in different units it was difficult to synthesize them mentally to gain an idea of the child's developmental status as a whole, and, indeed, an adequate interpretation of the different data could be given only by students in the fields represented. Some method of bringing these data together was needed which would permit describing the child as completely as feasible in easily interpreted quantitative terms and which would be concise enough to permit making such a summary for each child at regular intervals.

Accordingly, to facilitate interpretation and comparison, all the physical, psychological, social, and environmental data that furnished statistically adequate material (that is, a sufficient number of cases) were reduced to a common unit, the percentile rank. This method was chosen because it does not assume a normal frequency distribution in the data, an exigency that had to be provided for, and because it is readily understood by those untrained in statistical methods and so was of definite advantage in making the material readily accessible to parents, students, and staff. The traits for which sufficient data were available to permit the construction of percentile tables of standards were the following:

- Standing Height
- Weight
- Weight-Height Index
- Stem Length
- Recumbent Length
- Stem-Stature Index
- Stanford-Binet Mental Age Values
- Merrill-Palmer Scale Scores
- Goodenough Drawing Test Scores
- Scores on Monroe Drawing Scale
- Scores on Merrill-Palmer Personality Rating Scale
- Activity Ratings (Merrill-Palmer Scale)
- Diet:
  - Energy Intake (Calories)
  - Protein Intake (Grams)
  - Fat Intake (Grams)
  - Carbohydrate Intake (Grams)
- Time Required to Eat Lunch
- Time in Bed at Night
- Regularity of the Night Bed Hour
- Absences: Causes
  - Colds
  - All Illnesses

In all traits where there is likely to be a sex difference, separate tables were constructed for boys and girls, and in the case of the Stanford-Binet and

Merrill-Palmer scales separate tables were prepared for the first test and subsequent retests, to provide for the practice effect obtaining from the first test to the second and continuing through the fourth retest. In all, therefore, percentile tables were constructed for twenty-nine different factors relating to the child. These percentile tables of standards, together with a full account of the records upon which they are based and the statistical significance and use of the tables, are available in a bulletin entitled *The Merrill-Palmer Standards of Physical and Mental Growth* (14).

A brief discussion of the present percentile standards will indicate their general derivation, significance, and use.

The Standing Height standard shows the percentile rank of the child's height as compared with that of other children of the same sex and age in months. The Weight for Height standard compares the child in mass to other children of the same height and sex, irrespective of age, and the Weight-Height Index compares the child's rank in this trait to that of other children of the same age. In the Stem Length, Recumbent Length, and Stem-Stature Index standards, the child is compared to children of the same age and sex. The stem length is the length of the body from the top of the head to the buttocks (the "crown-rump length" in the terminology of Boyd (1)), and the recumbent length, like the standing height, is a measure of total body length, taken in a supine position. The stem-stature index measures the child's body type, whether stocky or long limbed.

In the Stanford-Binet and Merrill-Palmer scale standards, and in the Goodenough test (3) standard, which is based upon ratings of the child's drawing of a man as compared to a scale and is regarded as a measure of intelligence, the child is compared to children of the same age in months; in the Stanford-Binet and Merrill-Palmer scales he is compared also with children who have had the same relative experience with the tests as himself—that is, there is one standard for the first test and another for subsequent retests up to the fourth.

In the Merrill-Palmer Personality Rating Scale standard the child is compared with other children in five types of behavior, i.e., Effective Energy, Mental Effectiveness, Emotional Control, Social Adjustment, and Skill in Work and Play (14, pp. 18–21). In the Merrill-Palmer Activity Rating Scale (10) standard the child is compared to all other nursery school children (not those of his own age only) in fifteen types of activity, according to a five-point scale indicating the intensity of the activity. In the Time to Eat Lunch standard, a measure of the child's dispatch in this matter, the child is compared with other children of the same age in years. The time the child takes to eat lunch (when the age is held constant) is partly a measure of appetite, partly of a general tendency to dally, and partly of sociable or mischievous behavior; indirectly, it is a measure of the amount of trouble the child gives the nursery school teachers, for continual dawdling in this part of the

program calls for much patience and tact from the adults in the nursery school. In the Time in Bed at Night and Regularity of the Bed Hour standards, the child is compared with children of the same age in years; and in the standards measuring the child's relative freedom from colds and all illnesses, respectively, the child is compared with the younger (24 to 41 months) or older (42 to 59 months) of two preschool age groups, according to his age. In the Biogram some of the terms used for the traits measured have been changed slightly from those used in the *Standards* (14), partly to secure brevity and partly to indicate that the Biogram shows an individual *rating*, while the standard shows, more strictly, a distribution of measures. In the Diet standards (calorie, and protein, fat, and carbohydrate intake in grams per pound of body weight), the child is compared with other children of the same age in months. In the Monroe Drawing Scale standard, the quality of the child's free-hand paintings in the nursery school is compared with that of other children of the same age in months on the basis of a rating scale (6).

Since the standards are based upon data for the Merrill-Palmer nursery school children, a superior group, it is probable that a group more nearly representative of the general population would show different distributions and averages (14, pp. 9–10, 35). It is also probable, however, that the Merrill-Palmer group is fairly representative of the nursery school population connected with child development research centers.

The reduction of the data to a common unit and the determination of percentile standards made it possible to show the ranking of the individual child in any trait in relation to that of all other Merrill-Palmer children (or those of the same grouping) in this trait, and to integrate these ranks into as complete a quantitative picture of the child as the thoroughness of the measures now taken will permit. To give this "quantitative picture" a graphic form, the "Biogram," similar to the "psychograms" used in the mental testing field, was devised (fig. 1). Ideally, the Biogram attempts to give a complete quantitative picture of the preschool child at a given age—showing his rank in many traits relating to physique, mentality, personality, habits, and environment. Actually, the Biogram at the present time shows the rank of the child in several anthropometric factors; three mental tests; a personality rating scale; an activity rating scale; health; such physical habit factors as amount and regularity of sleep and dispatch in eating the school lunch; diet; and one measure of aesthetic aptitude, the child's rating in free-hand painting. Until the items included in the Biogram are themselves sufficient to describe the child, it is intended that each Biogram shall be accompanied by a qualitative description, furnishing such additional facts as are significant. It is probable that supplementary notes will always be necessary when a complete record is desired.

In judging the status of the child as measured by his percentile rankings and as indicated by the Biogram, some classification of inferior, average, and

superior zones and an idea of the position of the optimum in the various traits are of course necessary as a standard of comparison. Though further study is needed to establish the position of the optimum in some traits

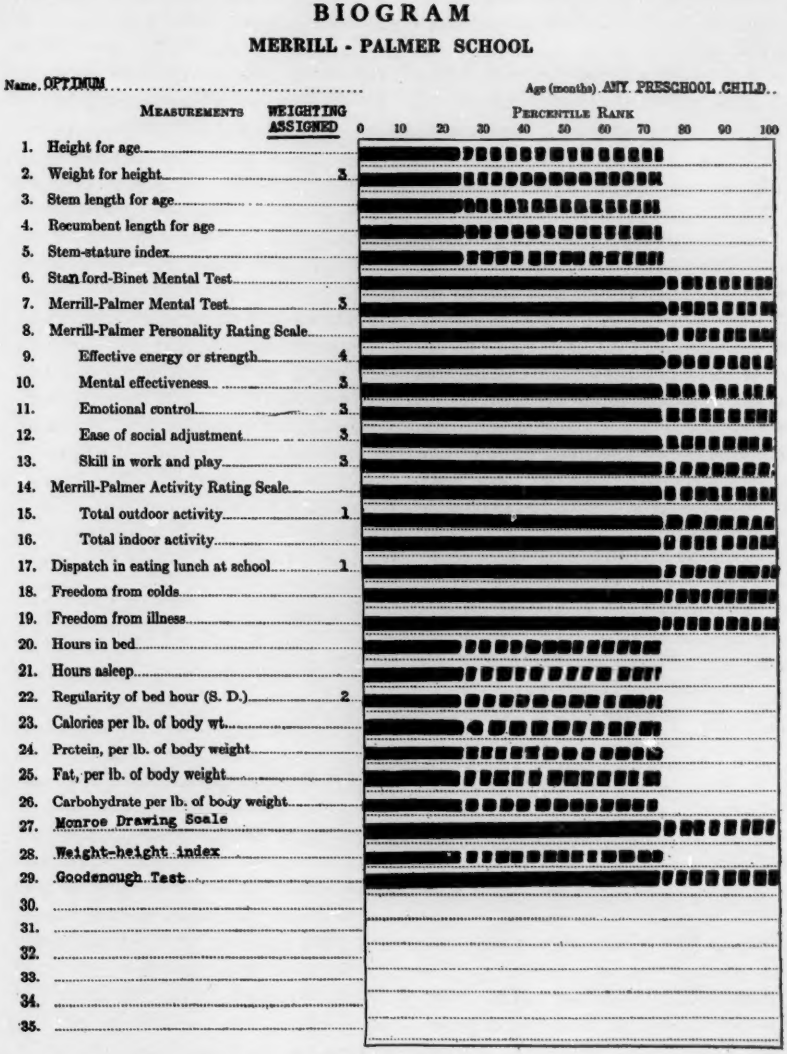
BIOGRAM
MERRILL - PALMER SCHOOL
Name. OPTIMUM
Age (months) ANY PRESCHOOL CHILD
MEASUREMENTS
WEIGHTING ASSIGNED
PERCENTILE RANK
0 10 20 30 40 50 60 70 80 90 100
1. Height for age
2. Weight for height 3
3. Stem length for age
4. Recumbent length for age
5. Stem-stature index
6. Stanford-Binet Mental Test
7. Merrill-Palmer Mental Test 3
8. Merrill-Palmer Personality Rating Scale
9. Effective energy or strength 4
10. Mental effectiveness 3
11. Emotional control 3
12. Ease of social adjustment 3
13. Skill in work and play 3
14. Merrill-Palmer Activity Rating Scale
15. Total outdoor activity 1
16. Total indoor activity
17. Dispatch in eating lunch at school 1
18. Freedom from colds
19. Freedom from illness
20. Hours in bed
21. Hours asleep
22. Regularity of bed hour (S. D.) 2
23. Calories per lb. of body wt.
24. Protein, per lb. of body weight
25. Fat, per lb. of body weight
26. Carbohydrate per lb. of body weight
27. Monroe Drawing Scale
28. Weight-height index
29. Goodenough Test
30.
31.
32.
33.
34.
35.

FIG. 1. BIOGRAM SHOWING OPTIMUM RANKS IN PERCENTILES

and to fix the limits of the three zones in all traits, these points can be determined roughly. The percentiles are all arranged from 1 to 99, and superiority in a trait is in general indicated by a high percentile rank (right end of the scale), and inferiority by a low rank (left end of the scale) (fig. 1). In some traits, however, the median probably represents the optimum, e.g., in any measure of body proportion. In body weight, for instance, a rank in the first quartile is probably less desirable than a rank in the highest quartile; but a rank in the highest quartile is, in turn, less desirable than a rank in the second or third quartile. The reason for placing the optimum for body weight in the interquartile range is fairly obvious. A decision concerning the optimum position for the measures of body length is less important. It was decided that from an aesthetic point of view, at least, the optimum in these traits was best placed in the interquartile range. We have assumed (fig. 1) that the median is also the optimum in the following traits: sleep (hours in bed, hours asleep, and regularity of the bed hour), and diet (calories, and protein, fat, and carbohydrate intake in grams per pound of body weight). There were insufficient data on the food intake of the children included in the study to permit the inclusion of a ranking on these traits.

It was difficult to locate the optimum in two traits; namely, dispatch in eating lunch and activity. The optimum for dispatch in eating lunch has been placed in the upper quartile; that is, it is considered that the more rapidly a child finishes his meal, the more desirable is his behavior in this respect. Certainly this is true if the adults in charge of the child are to be considered. But, more important, experience shows that a dispatch in eating lunch that places the child in the upper quartile is advantageous to him. The time corresponding to the 99 percentile in this trait—that is, the time spent at lunch by the most rapid eaters among the four-year-olds—is 19 minutes. Members of the physical growth staff who have watched many nursery school children say that a child who finishes in nineteen or twenty minutes the amount of food given him is not gulping his food or failing to masticate; rather, this dispatch in finishing the meal indicates a good appetite, skillful motor control, and a lack of dawdling or mischievous behavior. The present position of the optimum in activity—in the upper quartile—is also controversial. Theoretically, it is as undesirable for the child to be hyperactive as to be hypoactive. However, it was found that the children who were considered relatively superior tended to rank much nearer to the 75 percentile than to the 50 percentile in outdoor play; and that the children who were considered relatively inferior tended to rank below the 50 percentile. Further, an examination of the percentile table for activity shows that, while the scale has five points, the upper points are little used in rating children or, at least, tend to disappear in the averaging process. The 90 percentile in outdoor play, for example, is 2.86, or almost 3, the theoretical midpoint on the scale. The descriptive phrases accompanying

this point on the scale indicate only a healthy degree of activity, not hyperactivity.

However, while the present placing of the optimum in the various traits is probably to be considered correct for the majority of cases, it must be emphasized that in certain traits, e.g., amount of sleep, regularity of the bed hour, etc., the optimum may vary considerably in individual cases.

The Biogram has been in use since the early months of 1929 and has demonstrated its usefulness in acquainting the nursery school teachers with the children's standing in various quantitative measures taken by the staff, and thus serving as a guide in their care of individual children; as a basis for discussion of the children in classes for the students studying child care and training and in staff committees; and as a means of showing the child's parents, in a graphic way, how the child stands with reference to the whole group in all the traits measured. As an instrument of parent education, it is especially useful in showing the child's rank in items for which the home is directly responsible, i.e., sleep and food.

PROCEDURE

For the present study, intended to test the efficiency of the Biogram in differentiating children considered to be relatively superior and inferior, the subjects were chosen as follows:

A list of the 50 children registered in the Merrill-Palmer nursery school in April, 1929 was sent to 39 staff members and graduate students who knew the children best, with the request that they place a plus sign before the names of the 10 children they considered most desirable from all points of view—physical, mental, and social—and a minus sign before the names of the children they considered least desirable from the same points of view. That is, an attempt was made to secure a subjective rating which would be comparable to the objective rating of general superiority and inferiority presented by the Biogram.

The number of votes, favorable and unfavorable, for each child who had been voted for were then added algebraically and the children ranked accordingly. Seven of the 50 children originally included had to be excluded from the study because certain essential quantitative data were lacking from their records. This left 43 participating in the final ranking. The percentage of favorable votes received by the first ten of the "desirable" children (to be called the "D" group) varied from 94.8 to 48.7 per cent, while the percentage of unfavorable votes received by the first ten of the "least desirable" children (to be called the "U" group) varied from 82.1 to 41.0 per cent (table 1). That is, there was more agreement upon desirability than upon undesirability. This disagreement upon the ten "least desirable" children may be attributed to two causes. In the first place, the nursery school children, as noted before, do not represent an unselected sample of the population. The median mental age of the children on the Stanford-Binet Scale is about seven months higher than their chronological age, and an unselected group of thirty who were measured by the

Sims Scale for Socio-Economic Status showed (according to the New Haven standardization) a median percentile at the 90 percentile, an interquartile range between the 80 and 95 percentiles, and the lowest family at the 60 percentile of the Scale. The fact that the children come from relatively superior homes and would not be considered undesirable as compared to a random sampling, but are so only in relation to their more desirable schoolmates, makes the selection doubly hard for the judges and probably largely accounts for their disagreement. Secondly, both the staff and students are keenly interested in and analytical of each child in the nursery school, and so no child appears to be without virtue. Only 1 of the 10 D children had less than a majority of votes, while 5 of the 10 U children had less than a majority of votes. None of the 43 children received less than 3 votes, whether favorable or unfavorable. However, among the 10 D children, only one child, 10-D, received any unfavorable votes. For convenience, the child who received the greatest number of favorable votes will be designated as 1-D, the one who received the next highest number as 2-D, etc.; the children of group U are similarly designated as 1-U (the child

TABLE 1

Number and percentage of favorable and unfavorable votes received by the children of the D and U groups

CHILD	SEX	AGE MONTHS*	FAVORABLE VOTES		UNFAVORABLE VOTES		NET VOTES	
			Number	Per cent	Number	Per cent	Number	Per cent
1-D	F	60	37	94.8	0	0.0	37	+94.8
2-D	F	59	35	89.8	0	0.0	35	+89.8
3-D	M	46	33	84.6	0	0.0	33	+84.6
4-D	F	55	30	77.0	0	0.0	30	+77.0
5-D	M	45	29	74.4	0	0.0	29	+74.4
6-D	M	60	26	66.7	0	0.0	26	+66.7
7-D	F	49	22	56.4	0	0.0	22	+56.4
8-D	F	53	22	56.4	0	0.0	22	+56.4
9-D	F	24	21	53.8	0	0.0	21	+53.8
10-D	M	55	19	48.7	2	5.1	17	+43.6
1-U	F	58	0	0.0	32	82.1	32	−82.1
2-U	F	43	0	0.0	28	71.9	28	−71.9
3-U	F	30	0	0.0	27	69.2	27	−69.2
4-U	F	51	0	0.0	24	61.6	24	−61.6
5-U	M	59	0	0.0	20	51.4	20	−51.4
6-U	F	54	0	0.0	19	48.7	19	−48.7
7-U	F	54	1	2.6	19	48.7	18	−46.1
8-U	M	47	0	0.0	17	43.6	17	−43.6
9-U	F	34	0	0.0	16	41.0	16	−41.0
10-U	F	53	1	2.6	16	41.0	15	−38.5

* Age on March 1, 1929; the Biograms were made from two to four months earlier.

who received the greatest number of unfavorable votes), 2-U, etc. (table 1). One of these two unfavorable votes was given by a student who was especially successful in the nursery school and the other by a Japanese student. There is some reason to suppose that child 10-D, who is extremely negative to student authority, might seem undesirable to some persons because of this trait. Among the U children, two (7-U and 10-U) each received one favorable vote. Both of these votes were given by two members of the staff who knew the children in a special situation (the medical and psychological examinations) rather than in the nursery school.

The predominance of girls in both D and U groups, but especially in the U group, is perhaps not significant, owing to the small number of cases. However, it may be suggested that the judges, all but one of whom were women, might have been more sensitive to the virtues and faults of children of their own sex and might therefore be likely to place them at the extremes of desirability and undesirability. There were equal numbers of boys and girls in the nursery school at the time the study was made.

The median age of the D group at the time the votes were cast (table 1) was 54 months, and of the U group, 52 months, while that of the entire 43 children included in the study was 46 months. That the D and U children were selected from among the older children is probably to be attributed to the more defined traits of older children as compared with younger ones. The fact that about half the judges who were staff members had known the older children over a longer period of time than they had known the younger ones may also have been a factor.

To summarize: The 10 children of group D have distinct virtues and the 10 children of group U have distinct faults which make them appear, to the 39 adults who judged them, relatively desirable or undesirable.

Owing to the small number of cases, statistical formulas could not be used in comparing the two groups. It appeared to be most fruitful to make two simple comparisons of the two groups in each of the traits measured, as follows:

1. The distribution of the percentiles of the D and U groups among the quartiles of the percentile scale.
2. The median percentiles for the D and U groups, respectively (fig. 2).

FINDINGS

Differences between the Superior and Inferior Children in Single Traits

The summary in table 2 shows the number of D and U children, respectively, in the lower quartile (below average), interquartile range (average), and upper quartile (above average), and the median percentile of each group, in each of the traits measured. See fig. 2 also.

The table shows that the D children are slightly taller than the U children, though the difference is not great. In weight, there is a marked difference in the two groups. Of the U group, 7 of the 10 children were underweight, while 6 of the 10 D children were of average weight, tending toward the

TABLE 2

Differences between the desirable and undesirable children in single traits

TRAIT	N	LOWER QUARTILE 1–24	INTER-QUARTILE RANGE 25–75	UPPER QUARTILE 76–99	MEDIAN PER-CENTILE	DIFFER-ENCE IN MEDIANS (PERCEN-TILES)
Standing Height						16
D	10	3	6	1	46	
U	10	4	4	2	30	
Weight for Height						50
D	9	0	5	4	69	
U	10	7	2	1	19	
Stem Length						9
D	10	3	6	1	43	
U	10	4	4	2	34	
Recumbent Length						16
D	10	4	5	1	44	
U	10	5	3	2	28	
Stem-Stature Index						15
D	10	1	7	2	42	
U	10	4	5	1	27	
Weight-Height Index						36
D	10	1	6	3	58	
U	10	6	4	0	22	
Stanford-Binet Test						47
D	9	0	6	3	65	
U	8	5	2	1	18	
Merrill-Palmer Test						58
D	9	0	4	5	80	
U	10	6	3	1	22	
Personality Rating						76
D	10	0	4	6	92	
U	10	7	3	0	16	
Effective Energy						76
D	10	1	1	8	90	
U	10	6	4	0	14	
Mental Effectiveness						66
D	10	0	3	7	86	
U	10	7	3	0	20	
Emotional Control						63
D	10	1	2	7	86	
U	10	6	4	0	23	
Ease of Social Adjustment						60
D	10	0	5	5	76	
U	10	6	4	0	16	
Skill, Work and Play						66
D	10	0	2	8	86	
U	10	6	4	0	20	
Activity Rating						15
D	9	1	7	1	60	
U	10	2	7	1	45	

TABLE 2—*Concluded*

TRAIT	N	LOWER QUARTILE 1–24	INTER-QUARTILE RANGE 25–75	UPPER QUARTILE 76–99	MEDIAN PER-CENTILE	DIFFERENCE IN MEDIANS (PERCENTILES)
Outdoor Activity						23
D	8	1	5	2	68	
U	10	2	7	1	45	
Indoor Activity						0
D	9	0	8	1	50	
U	10	2	7	1	50	
Dispatch, Eating Lunch						20
D	10	3	4	3	42	
U	10	5	3	2	22	
Freedom from Colds						0
D	10	1	8	1	99	
U	10	3	1	6	99	
Freedom from Illness						10
D	10	1	1	8	99	
U	10	2	2	6	89	
Number of Hours in Bed						13
D	10	2	7	1	51	
U	10	1	5	4	64	
Regularity, Bed Hour						30
D	10	0	6	4	60	
U	10	2	1	7	90	
Diet: Data not available	—	—	—	—	—	—
Monroe Drawing Test						5
D	9	4	4	1	25	
U	9	3	6	0	30	
Goodenough Test						25
D	8	1	6	1	60	
U	8	3	5	0	35	

upper quartile. It is natural that weight should have influenced the judges in their choice, since thinness is readily recognizable as presumably an index of poor nutrition, and a rosy, well-nourished child would of course be chosen as more desirable, from an all-round point of view, than a thin, poorly nourished one. Franzen (2) found that weight was mainly a product of several skeletal measurements, and that variation from the standard for a certain height did not necessarily imply nutritional deficiency, but might rather mean differences in chest and hip breadth and depth. The data for stem length and recumbent length show the D children to be slightly longer-bodied than the U children, and the data for the stem-stature index show a slight preponderance of short-limbed children in the U group. Like the data for weight, the weight-height index shows a distinct difference in the two groups, with most of the D children in the middle and upper quartiles, and the greater number of U children in the lower quartile. The differences of the two groups in anthropometric measures thus agree

with those noted in *Genetic Studies of Genius* (11), where the mentally superior children were found to be taller and heavier than an unselected group of children. In the present study, however, the D and U children differed much more in body weight than in height.

The data show that intelligence plays an important part in discriminating between the two groups. Thus in the Stanford-Binet test, the median rank of the D group is 47 percentiles above that of the U group; in the Merrill-Palmer test, 58 above; and in the Goodenough test, which distinguishes less clearly between the two groups, the median of the D group is 25 percentiles above that of the U group. The Goodenough test is separated from the other mental tests on the Biogram merely because the percentile standards for this item became available later than those for the other two.

As might be expected, the personality ratings of the two groups, as measured by the Merrill-Palmer Personality Rating Scale, differ markedly, indicating that the judges considered personality to be one of the most important factors in determining the general desirability or undesirability of the child. In total score, the median of the D group is 74 percentiles above that of the U group, and the first six of the D children all rate above the 90 percentile. Conversely, 7 of the 10 U children rank below average. Of the five divisions of the scale, the division called "Effective Energy" shows the greatest disparity between the groups. Here the median of the D group is 76 percentiles above that of the U group. The statements indicating possession of "Effective Energy" in the scale are as follows:

Skillful in body control; good coördination.
Vigorous and energetic in his attack of a project.
Sturdy, strong, robust.
Independent (considering age); self-reliant.
Adventurous; challenged by the untried.
Participates in activity.
Physically vigorous; alert; energetic.
Nearly always accomplishes task in spite of difficulties.
Voice animated, alive.
Does not become fatigued easily.

The two groups differ little in activity, as measured by the scale used. In indoor activity, the median for both groups is the 50 percentile. In outdoor activity, the D children rate somewhat higher than the U children. That this difference is not greater than it is may be attributed in part to faulty use of the measure, rather than to a true lack of distinction between the two groups in this respect.

As noted before, there is a tendency in practice to disregard the upper extremes of the five-point rating scale, though observation shows that the children do in fact indulge in the kinds of activity described in the phrases under these points. This distortion in rating may be explained by the fact that the scale is adjusted more accurately to the activity of the five-year-old than to that of the two- or three-year-old, and that when an equal number of children of two or three years of age and children of five years of age are observed, this discrepancy tends to move the actual

median below the theoretical one. Thus, while the 3d point in the scale should coincide with the 50 percentile, it coincides in practice with the 99 slightly below average. The scale is at present being revised.

In dispatch in eating lunch, the median of the D group is 20 percentiles

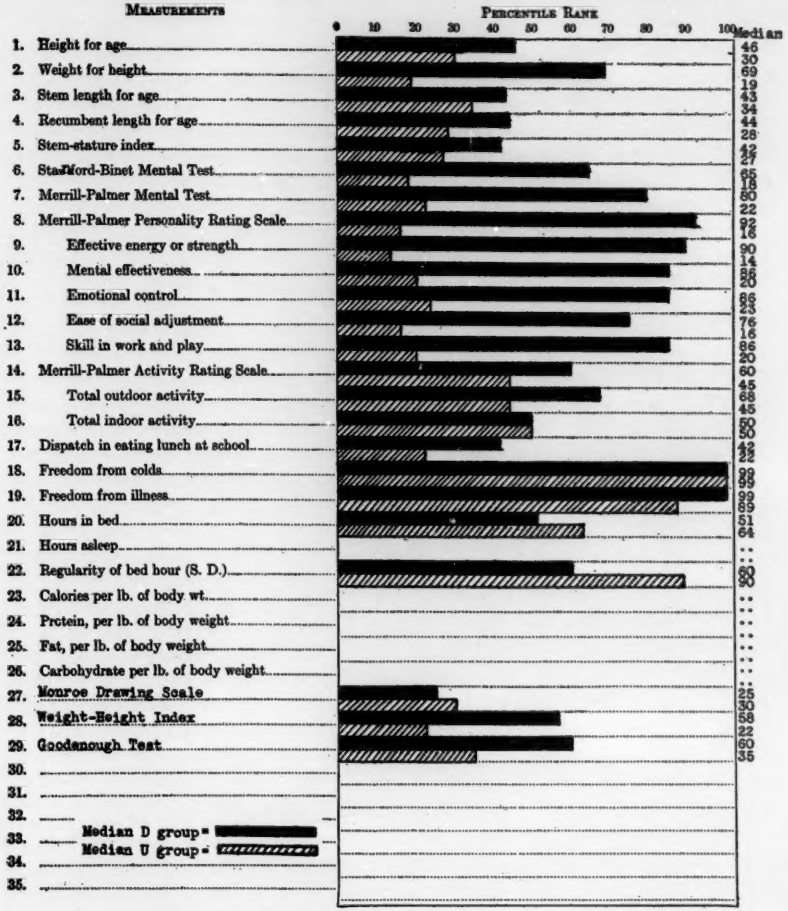

FIG. 2. MEDIAN PERCENTILES OF THE D AND U GROUPS COMPARED

percentile; and the actual median coincides with the 2d point, originally intended to describe a type of activity higher than that of the U group. That the median for the U group falls in the lower quartile indicates that

these children eat more slowly than do the Merrill-Palmer children of their age group, considered as a group. The five U children who fall in the lowest quartile represent distinct food problems, and it is not surprising that four of the five are underweight according to the Merrill-Palmer standards. The fifth child is a rather unhappy, introverted, day dreaming child, who, without being physically inferior, was still negative toward all the nursery school regime after three years of attendance. As has been suggested, the significance of this measurement—dispatch in eating lunch—is greater than appears at first glance. Children vary greatly in this matter. Some serve themselves with agility and neatness, have a good appetite, and do not talk or play overmuch; others, who have no appetite or have certain food dislikes, use many sorts of delay devices—mischievousness, daydreaming, frequent trips to the toilet, or regurgitation. Behavior of this sort calls for considerable skill in the student or teacher. Thus a child who is a food problem is also a behavior problem, and so might be considered undesirable even from a general point of view by the adults judging him subjectively. In addition, since a relation would be expected to obtain between appetite and body weight, and body weight is so important a factor in the general rating, the child's dispatch in eating lunch would naturally be associated (though less strongly than body weight) with the idea of general desirability. The results show this to be so.

In freedom from colds there is some slight difference in favor of the D group, but the medians for both groups are at the 99 percentile. In freedom from all illness (including colds), the median of the D group is 10 percentiles above that of the U group. In each of these standards, the basis for the percentage was the number of days for which there was a record of the child's health. The standards are based upon data for all months of the school year, and hence seasonal variation is not a factor. A study made at the School shows that colds occasioned from 39.5 per cent to 79.1 per cent of the absences of the older children, and from 39.5 per cent to 81 per cent of those of the younger group. Colds were found to be most prevalent among the older group in February; in the younger group, in February and November. They were least so among the older group in April; among the younger group, in September. In all but two of the Biograms of the present study, the data on absences were taken during one of the months between September and December. In but one case (9-U) was the child's health unfairly represented by having the record made during the month when colds were most prevalent among children of her age group.

In the number of hours in bed and the regularity of the bed hour, where the position of the optimum is controversial or may be expected to vary in individual cases, the D children tend to rank in the interquartile range—that is, to have an average amount of sleep and a fairly regular bed hour. The U children, on the contrary, tend to rank in the upper quartile in both traits, and the median of the U group is in both cases higher.

As figure 1 shows, the optimum in these traits is at present considered to be at the 50 percentile. The reasoning back of this placement of the optimum was that, for the normal, healthy child, an average amount of sleep and an average regularity of the bed hour are more desirable than the greatest possible amount or degree for the child of his age, since habits are intended to free the individual, not to hamper him. The fact that the greater number of D children were in the interquartile range may substantiate this judgment. The one child of the D group (7-D) who was in the upper quartile had albuminuria, and all four of the U children who had more than the average amount of sleep were underweight, which indicates that their parents had attempted to adjust their sleeping schedules to their health. There is an even greater disparity in the regularity of the bed hour of the two groups, the median of the U group showing a considerably greater regularity for the group than the D group has. These results do not imply, of course, that short sleeping hours or irregular bed hours are desirable for young children, or that they tend to produce desirable children; but rather, that it is desirable that the child have the amount of sleep representing the average for his age (11 hours, 45 minutes for the two-year-old; 11 hours, 30 minutes for the four-year-old), and that the bed hour vary within the average limits (24 minutes on either side of the usual time), unless the child is nervous or poorly nourished. At present there are not enough data to permit a comparison of the hours the child is in bed and the actual number of hours he sleeps.

The data on food intake are not available for the children included in the study.

Neither group shows any particular aptitude in free-hand drawing, as measured by the Monroe Drawing Scale, and there is little distinction between the two groups in this respect.

To summarize: Children of preschool age who have been designated as especially desirable by adults observing them in the nursery school tend to be average or slightly above average in weight, height, stem length, and body build; to be above average in intelligence and personality traits, especially in effective energy; to be somewhat above average in activity, especially outdoor activity; to eat their nursery school dinners in average time; and to be exceptionally free from colds and other illnesses. They have an average number of hours in bed and an average regularity in their hour of going to bed. They do not show any superiority in free-hand drawing.

Children of the same age considered relatively undesirable by the same adults present an entirely different picture. They are underweight and tend to be shorter both in total height and stem length than the superior group are, and to be shorter in limb. They are below average in intelligence and personality traits, and especially so in effective energy and ease of social adjustment. They are somewhat less active than the desirable children. They eat their dinner at the nursery school with less than average dispatch and are slightly more

susceptible to colds and other illnesses than are the desirable children. On the other hand, they spend more time in bed and are more regular in their bed hour than the desirable children are; this surprising difference is due, however, not to the superiority of the homes of these children—for a subjective rating indicates that the children of group D come almost without exception from intelligent, fairly prosperous parents, while at least six of the children of group U come from homes below the average for the School economically and socially—but in part at least to the persistent educational program which goes out from the School to the home, especially in the case of thin, less healthy children. The undesirable children equal the desirable children in one trait only—drawing ability, and neither group shows particular talent in this direction. Terman (11) found the average IQ of a class of fifty children chosen from all the schools of Los Angeles for superior ability in the graphic arts to be 109, with a range of 79 to 133. This may indicate either that artistic ability does not tend to be associated with intelligence or that, as Terman suspects, and as there is considerable evidence to show, exceptional talent in painting and drawing is less likely than musical ability to appear precociously, and that these fifty subjects had little more than copying ability.

Differences between the superior and inferior children in total make-up (the Biogram as a measure of the whole child)

It appeared, however, that not only would the Biogram show group differences, but also that it could be used in individual cases as a measure of the child as an integrated organism. The study offered one means of measuring the success of the Biogram for this purpose; that is, a comparison of the child's Biogram rank, as determined by the total of his ranks in the several traits, with his rank according to the ratings of the thirty-nine judges. Before this comparison could be made, it was necessary to work out a method of totalling the Biogram from ranks in single traits. Two general methods of securing a total rank were tested. The first, consisting of a ranking of the children from high to low according to the number of optimums on their Biograms, did not show any great degree of correspondence between the ranks according to the judges and those of the Biograms. A scoring system was then worked out, as follows: A percentile rank located within the optimum range was given a score of 3. Thus, if the optimum corresponded with the interquartile range, a rank from 25 to 75 was given a score of 3; a rank from 76 to 99 was given a score of 2; and one from 1 to 24, a score of 1. If the optimum corresponded with the upper quartile, a rank from 76 to 99 was given a score of 3; a rank from 25 to 75 a score of 2; and one from 1 to 24 a score of 1. Since it was obviously unsound to assign equal rank to traits of such varying importance as intelligence and dispatch in eating lunch in adding the list, a series of weights for the various traits was the next requirement. After experiment proved several commonsense methods of weighting to be unsuccessful, an objective method, based upon the difference between the medians of the D and U groups in the various traits (fig. 2), was tried and adopted when it was

found to give a higher degree of correspondence between the two rankings. On this basis, the following series of weights was worked out:

DIFFERENCE OF MEDIANS (PERCENTILE POINTS)	WEIGHT
Greater than 75	4
50–74	3
25–49	2
20–24	1
Less than 20	Trait not included in score

Of the several items of the Biogram which represent different measures of the same trait, such as the three tests of intelligence, the two measures of body length, and the two measures of body weight, the measure that discriminated best between the two groups was included and the others were omitted; and those Biogram items representing a summary of separate elements of traits, such as total personality rating (No. 8) and total activity rating (No. 14), were excluded in favor of the ratings in the separate elements.

The 10 of the 29 items of the Biogram remaining after this process of elimination and the weights assigned them by the method described were as follows:

BIOGRAM ITEM	TRAIT	WEIGHT
2	Weight for height	3
7	Merrill-Palmer test	3
9	Effective energy	4
10	Mental effectiveness	3
11	Emotional control	3
12	Ease of social adjustment	3
13	Skill in work and play	3
15	Total outdoor activity	1
17	Dispatch in eating lunch	1
22	Regularity of bed hour	2

This series of weights is interesting as showing the importance the judges attributed to the separate factors in the total physical, mental, and social make-up of the D and U children. Thus, after examination of the differences between the medians of the D and U groups (fig. 2) effective energy was given the greatest weight, and body weight with reference to height, intelligence (especially the kind measured by the Merrill-Palmer scale), and such personality factors as mental effectiveness, emotional control, ease of social adjustment, and skill in work and play were rated as of equal importance by the judges. Regularity of the bed hour is rated next, with outdoor activity and dispatch in eating lunch at the end.

The Biograms for each of the 43 children were then summarized quantitatively, according to this scoring and weighting system, and compared with the ranks given by the judges, as determined by adding algebraically the number of favorable and unfavorable votes given to each child and arranging these totals in order from the highest number of favorable votes to the highest number of unfavorable votes. The two ranks showed a correlation of $\rho = 0.82$ (Spearman Rank Difference Method). Accordingly, it may be said that a child's inherent general superiority or inferiority (relative to the group) may be determined by his total rank in the ten traits of the Biogram included in the scoring and weighting device, and by his rank in the separate traits to the extent indicated by the weights assigned to them.

Though the Biogram items not included in the scoring system, such as

diet and freedom from illness, are apparently not of great importance in determining the child's essential superiority or inferiority, they are useful as a measure of traits that contribute indirectly to the child's general quality.

The small number of cases in the present study and the many data available for each child make it possible to show not only the degree of correspondence between the subjective and quantitative ratings, but also why the correlation was not higher, through an examination of what may be called the spurious cases —those in which the two ranks did not agree.

It would be expected that the ranking of the children representing the middle of the distribution would show a considerable variation in the two ranks, but that the upper ten and lower ten (the D and U groups of the study representing the rank according to the judges) would show a close correspondence. An analysis will show how far this was true.

In this analysis it must be remembered that the 10 D children represent a much closer agreement among the judges than do the 10 U children. This explains in part the fact that the Biogram ranks and the ranks according to the judges show a greater disparity at the lower end of the rankings of the 43 children than they do at the upper end.

Eight of the ten best Biogram scores correspond to the 10 D children, as ranked by the judges. According to the Biogram ranks, the other 2 children (7-D and 8-D) have positions 15 and 18, respectively. The eight spurious cases are designated as 1-S, 2-S, etc. Cases 1-S and 2-S are in the D group (7-D and 8-D respectively); cases 3-S, 4-S, and 5-S are in the U group (cases 5-U, 6-U, and 10-U, respectively); cases 6-S, 7-S, and 8-S are in neither the D group nor the U group, but according to the ranks assigned by the judges were in the middle of the distribution of the 43 cases. An examination of the qualitative records concerning the 2 children should show the reason for this disparity in the 2 ranks. The Biogram of 7-D (1-S), which gives her 15th place among the 43 children, shows that she is of average intelligence, deficient in energy, slow in eating her lunch at school, and only average in making social contacts. The qualitative description, however, shows that the child has an affable manner and is coöperative in behavior, and these qualities have outweighed in the minds of the judges (as they doubtless should) her physical deficiency, probably caused by albuminuria. (Children 7-D and 8-D actually had positions 7.5a and 7.5b, as ranked by the judges.) The Biogram of 8-D (2-S), which gives her 18th place, shows an average standing in almost all traits as measured quantitatively, except in the anthropometric traits, where she is somewhat below average Here again the qualitative description shows that the child's affability and cooperativeness have offset her defects in the minds of the judges. On the other hand, child 6-S, who had a rank of 6.5 on the Biogram, yet received favorable votes

from only 7.7 per cent of the judges, evidently has some fault not measured by the Biogram which outweighed his good points in the minds of the judges, for the Biogram shows him to have the ideal rank in all traits except emotional control, skill in work and play, and intelligence (fig. 5).

TABLE 3

Ranks of the D and U children and spurious cases according to Biogram and 39 judges

CHILD	RANK IN 43	
	Biogram	Judges
1-D	2.5	1.0
2-D	6.5	2.0
3-D	2.5	3.0
4-D	5.0	4.0
5-D	1.0	5.0
6-D	4.0	6.0
7-D (1-S)	15.0	7.5
8-D (2-S)	18.0	7.5
9-D	9.0	9.0
10-D	8.0	10.0
1-U	37.5	43.0
2-U	39.0	42.0
3-U	41.5	41.0
4-U	40.0	40.0
5-U (3-S)	28.0	39.0
6-U (4-S)	29.5	38.1
7-U	33.0	37.0
8-U	37.5	36.0
9-U	41.5	35.0
10-U (5-S)	22.0	34.0
6-S	6.5	19.0
7-S	36.0	25.0
8-S	43.0	16.5

As noted before, the 10 children ranked lowest by the judges and by the Biogram show less correspondence than do the 10 children ranked highest (table 3). Seven of the 10-U children were placed in a similar position by the Biogram ranks. However, the child (8-S) who had the lowest score of the 43 on the Biogram had 12.8 per cent favorable votes; that is, about one-eighth of the judges considered him to be among the ten most desirable children in the nursery school. The Biogram showed him to have the least favored position in almost every trait—he was underweight; below average in intelligence, as measured by the Merrill-Palmer scale; was less than average in effective energy, mental effectiveness, ease of social adjustment, and skill in work and play; extremely slow in eating his school lunch; extremely irregular in his bed hour; and inactive indoors. His emotional control was above average, but not beyond the interquartile range. Again, child 7-S, who was given adverse votes by only about one-eighth of the judges, had a rank of 36 on the Biogram, where a low rank in the personality items gave him a low score.

The 3 children of the U group whose Biogram ratings did not correspond with the ratings given them by the judges ranked as follows:

CHILD	RANK IN 43	
	Biogram	Judges
5-U (3-S)	28.0	39.0
6-U (4-S)	29.5	38.1
10-U (5-S)	22.0	34.0

Child 6-U has the optimum position in weight and the next best position in effective energy, skill in work and play, dispatch in eating lunch, and regularity of bed hour. She has a rating below average in the Merrill-Palmer mental test, mental effective-

ness, emotional control, and ease of social adjustment. The personality study shows her to have a certain stubbornness and lack of response to adult suggestion which, coupled with an unattractive face and dress, have doubtless served to outweigh in the minds of the judges any consideration of her good physical condition and normal activity. Child 5-U is underweight, average in all the personality factors except mental effectiveness, in which he was below average, and average in intelligence. He is above average in his dispatch in eating lunch but extremely irregular in his bed hour. His personality study shows that, while not disobedient, he was unfriendly, withdrawn, and unassertive. Child 10-U presents a similar case. She has the optimum position in body weight and a rank of 2 in all the personality items and regularity of bed hour; she has the pessimum position only in the Merrill-Palmer test and in dispatch in eating lunch. Yet here too the child's unfriendliness to adults and her uncooperative spirit have outweighed these good qualities and placed her in the U group.

In each of these eight spurious cases the qualitative data bring out certain important facts which the Biograms alone do not show. Thus they make it clear that the 3 children who were ranked higher by the judges than by the Biogram are without exception friendly to adults and cooperative, while the 5 children ranked lower by the judges than by the Biogram are somewhat unfriendly and uncooperative. It would seem logical to suppose, therefore, that these factors of friendliness and cooperation had been uppermost in the minds of the judges when they rated the children; and further, that the Biograms tended to show as high a correlation with the ranks given by the judges as they did because the five personality items were given a good deal of weight in the Biogram scoring system, and that incorporated in the 100 statements making up the personality rating scale are many which measure these factors of friendliness and cooperation. An examination of the statements, however, shows that only five of them can be said to measure this response to adults. It might be suggested, also, that even though the personality scale does not measure, as such, the "social responsiveness" of the child, the halo of attractiveness surrounding the appealing child would nevertheless tend to influence his rank on the scale. This is not borne out, however, by the personality ratings of the five spurious cases in the D and U groups—each rating representing the average of five votes. The two D children whose Biograms did not place them as high as the judges did were both in the interquartile range in personality, and of the three U children placed higher by the Biograms than by the judges, two had an average rank in total personality.

However, though the high correlation (0.82) between the rank given by the judges and that of the Biogram, representing a combination of traits, and the fact that at least one (10-D) of the D children was rated by his nursery school teacher as the most negative child under her care prove that "social responsiveness" was not the only factor in determining the

judges' decisions, the clear-cut distinction between the two groups of spurious cases (those ranked higher and those ranked lower by the judges than by the Biogram) in this respect made some further consideration of the question desirable.

To determine to some degree how far the judges had been influenced by what Dr. Mark A. May (5) calls "social stimulus value," one of the nursery school teachers was asked to rank the children according to their possession of this quality. The experiment indicated that this quality had influenced the judges to some extent (or perhaps only that the superior children tend to have this trait while the others do not), for eight of the 10 children highest on her list correspond to the D children, while seven of the 10 children lowest on her list correspond to the U children. It is interesting to note that she included among the 10 highest children the boy (6-S) who had an excellent Biogram but received few favorable votes, and among the ten lowest, one of the children who had one of the worst Biograms but received a number of favorable votes. It is possible that this teacher, who is with the children every day and knows them better than the other judges, is influenced by the general quality of the children (which the Biogram should measure) even while she is considering their social stimulus value. That is, it is difficult to separate the influence of these two factors (general superiority and social stimulus value) in determining the child's rating ostensibly on the basis of one of them.

The general conclusion to be reached from a study of these spurious cases is that while the judges took into account the child's status in many of the items measured by the Biogram (some of them to a greater extent than others), they still had in mind certain additional qualities which the Biogram does not measure and which may be described as coöperativeness and social stimulus value. If the Biogram is to give a rating of the child which agrees perfectly with the opinion adults have of him, so that it can replace to a larger extent qualitative descriptions of the child in records and reports, it will be necessary to seek a measure of these two qualities. A study now under way at the School will furnish a further measure of personality factors.

One Biogram each characteristic of the D and U groups, together with one representing the spurious cases (as used here "spurious" means that the quantitative records of the children—as shown on the Biogram—and the opinion of the judges concerning them did not agree) each accompanied by a summarized qualitative description of the child follows.

I D GROUP

Child 1-D (Fig. 3)

Physical. Mary is a sturdy, muscular child, with fair hair, blue eyes, rosy cheeks, and a gentle, soft voice. She is pretty and feminine, but is as active and skillful on the playground as any boy. Her posture is poor, showing moderate knock-knee, markedly round shoulders, prominent abdomen, and a slight scoliosis. There are no other physical defects. The blood and urine are normal.

Mental. Mary has good motor coördination. Her language development has been excellent ever since her entrance. The

quality of her imagination is shown in her play, where she invents such games as "elephant and trainer," and in the Circle, where her mimetic ability has been apparent. An instance of her superior reasoning ability is her reply when she was asked, at 32 months, whether she had a sister: "No," she said, "but Tom (her brother) has one." She has no particular aptitude for the graphic arts, but is unusually responsive to music. She has an excellent memory and shows persistence and concentration in carrying out various projects.

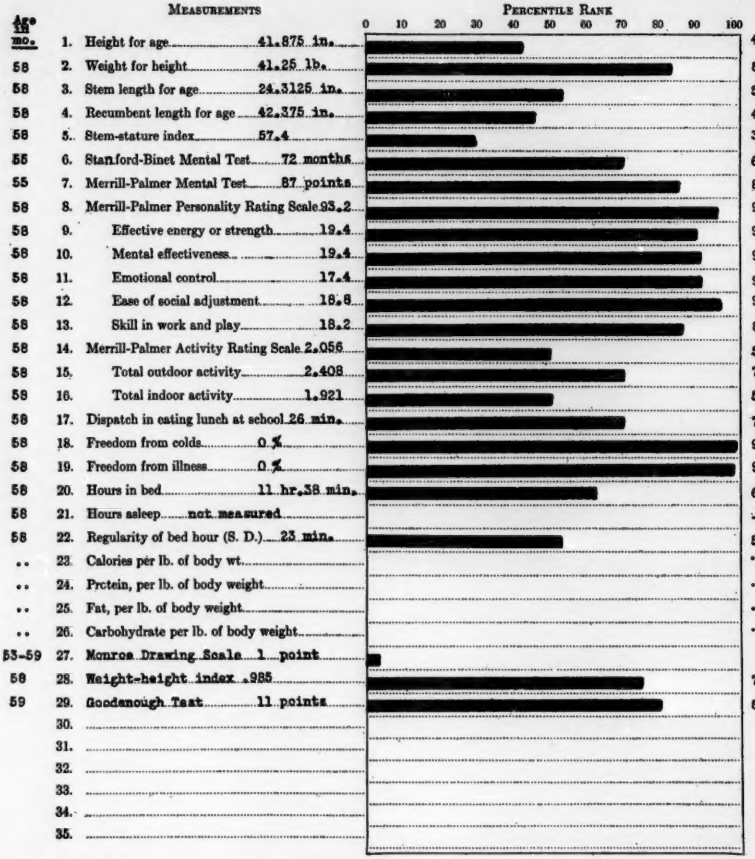
Age in mo.
Measurements
Percentile Rank
0 10 20 30 40 50 60 70 80 90 100
58 1. Height for age 41.875 in. 42
58 2. Weight for height 41.25 lb. 83
58 3. Stem length for age 24.3125 in. 53
58 4. Recumbent length for age 42.375 in. 45
58 5. Stem-stature index 57.4 30
55 6. Stanford-Binet Mental Test 72 months 65
55 7. Merrill-Palmer Mental Test 87 points 85
58 8. Merrill-Palmer Personality Rating Scale 93.2 95
58 9. Effective energy or strength 19.4 90
58 10. Mental effectiveness 19.4 91
58 11. Emotional control 17.4 91
58 12. Ease of social adjustment 18.8 97
58 13. Skill in work and play 18.2 86
58 14. Merrill-Palmer Activity Rating Scale 2.056 50
58 15. Total outdoor activity 2.408 70
58 16. Total indoor activity 1.921 50
58 17. Dispatch in eating lunch at school 26 min. 70
58 18. Freedom from colds 0 % 99.5
58 19. Freedom from illness 0 % 99.5
58 20. Hours in bed 11 hr. 38 min. 62
58 21. Hours asleep not measured ...
58 22. Regularity of bed hour (S. D.) 23 min. 53
.. 23. Calories per lb. of body wt. ..
.. 24. Protein, per lb. of body weight ..
.. 25. Fat, per lb. of body weight ..
.. 26. Carbohydrate per lb. of body weight ..
53–59 27. Monroe Drawing Scale 1 point 3
58 28. Weight-height index .985 75
59 29. Goodenough Test 11 points 80
30.
31.
32.
33.
34.
35.

FIG. 3. BIOGRAM OF CHILD 1-D (GIRL); BIRTHDATE: 1924–3–12; AGE (MONTHS): 58; DECEMBER 28, 1928–JANUARY 27, 1929

Personality traits. Mary's mood is generally happy. Her attitude toward the teachers is undemonstrative but affectionate. Though she is a leader of both boys and girls on the playground, she usually

devotes much of her attention to a single friend. She is unusually sympathetic with children who are hurt and loves to champion younger children. She is not self-centered or inclined to be jealous of the achievements of others. She seeks adult attention only when doing something worth while, and is slightly shy and self-conscious if given much attention. She responds well when spoken to and follows the nursery school regime without question. She possesses a good sense of humor.

Habits. Mary's sleep is sound and long both at night and during the nap. She eats all foods and finishes her lunch with neatness and dispatch. She is adept at dressing and washing herself.

Home environment. Mary comes from a simple, stable home, where her training has been unusually consistent and regular. The parents are of Anglo-Saxon stock. There is no history of serious physical or mental disease on either side. There is one other child, a boy 3 years older than Mary. The parents are well educated. They are affectionate but matter of fact with Mary.

Changes during three years at the nursery school. Since her entrance at 25 months of age, Mary has been an unusually well-adjusted child, considered every year, by various observers, to be the most desirable child in the school. Her personality has been essentially the same during these years. As is natural, her ability to make social contacts has steadily developed with growth. The shyness she showed at two years manifests itself, at five, in clownish behavior when she is observed too closely. She has been a healthy child, caring more for persons than things, coöperating in the school regime, concentrating well on the task at hand, and sweet-tempered and full of sympathy, though matter of fact.

II U GROUP

Child 1-U (Fig. 4)

Physical. Jane has a round baby face, light dry hair, and large brown eyes. Her body is plump, short, and stocky. Her voice is loud, whining, and shrill, and infantile in timbre. She holds her mouth wide open in smiling, disclosing both upper and lower teeth. A physical examination at 52 months showed fair development; fair posture, with slight round back and scoliosis, moderate forward head, and right shoulder high; good nutrition; and dental caries.

Mental. Jane is skillful in pasting and cutting and seems to enjoy painting and color sorting. She does not sing or respond to rhythms well. Owing to poor motor coördination, she is awkward and lumbering. She begins early in the morning to ask if it is time for her parents to come for her. She speaks slowly, with a kind of baby talk, but is easily understood; she uses short sentences. She has displayed little imagination in her play or table work, and we have few examples of her reasoning. She has not been able to concentrate well on a task, though of late she has shown some perseverance in completing paper mats and other work of this kind, mainly, however, to win the approval of the teacher. Her humor consists in the repetition of nonsense syllables, followed by loud laughter.

Personality traits. Jane's mood is invariably happy and contented. She often displays affection, rather indiscriminately throwing her arms violently around whomever she happens to be near at the time. The older children have teased her a great deal, and she sometimes evinces rage when they approach her; usually, however, she runs to an adult for protection. She is delighted if any attention is paid to her and is proud and pleased with any "work" she has done. She has shown jealousy only of other children sitting next to the teacher. She is often to be seen with a group of children who treat her like a baby. Her one constant friend is Rosalind (6-U, 4-S), who, like herself, is unable to compete socially with her chronological peers. She is easily led by others, is dependent upon the praise of adults, and accepts authority. She has no fear of strange adults, for she often approaches and talks to visitors. She is often anxious to acquire something belonging to another child and clumsily hides it in her pocket or locker to take home. Attempts to give her a sense of property rights have not succeeded. She is not always truthful.

Habits. Jane goes to sleep quietly dur-

ing the nap. Her appetite is good and she is reasonably tidy about eating, though rather awkward with her fork. Her elimination is perfected. In dressing and undressing she dawdles and asks for help at every step. She is in general resistant to the nursery school regime.

Home environment. The mother is the social inferior of the father, but probably contributes more than he does to the support of the family. Both are very serious about their lives.

Changes while in the nursery school. When Jane entered the nursery school at 40 months her babyish manner was rather cunning. At that time she disliked certain foods very much; now she eats all foods heartily. She has always been very immature physically for her age. During her two years in the nursery school she has

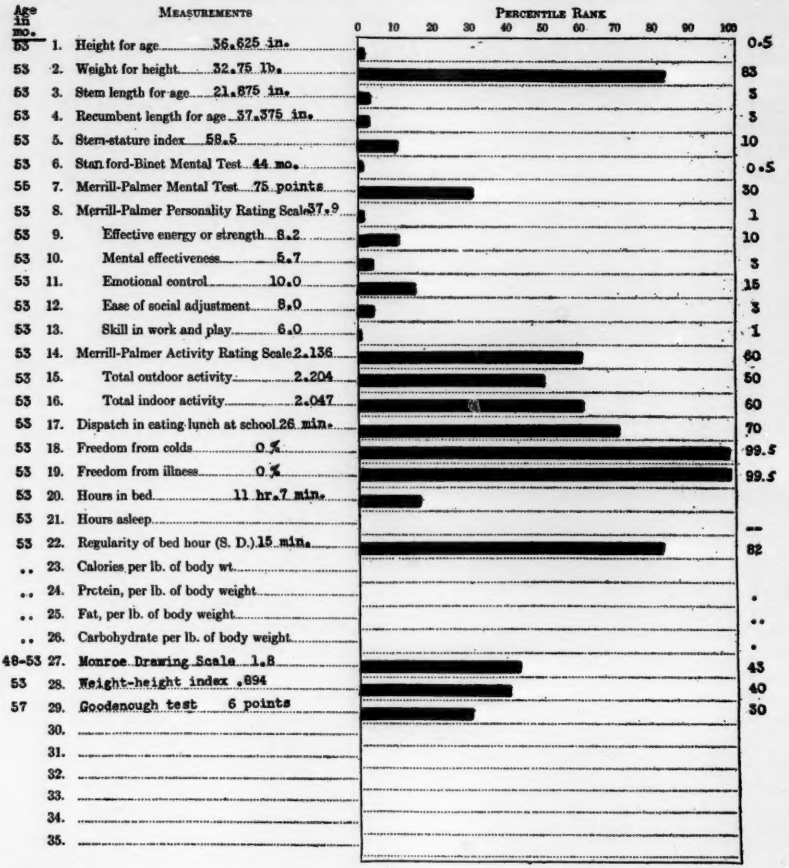
Age in mo.
Measurements
Percentile Rank
0 10 20 30 40 50 60 70 80 90 100
53 1. Height for age 36.625 in. 0.5
53 2. Weight for height 32.75 lb. 83
53 3. Stem length for age 21.875 in. 3
53 4. Recumbent length for age 37.375 in. 3
53 5. Stem-stature index 58.5 10
53 6. Stanford-Binet Mental Test 44 mo. 0.5
55 7. Merrill-Palmer Mental Test 75 points 30
53 8. Merrill-Palmer Personality Rating Scale 37.9 1
53 9. Effective energy or strength 8.2 10
53 10. Mental effectiveness 5.7 3
53 11. Emotional control 10.0 15
53 12. Ease of social adjustment 8.0 3
53 13. Skill in work and play 6.0 1
53 14. Merrill-Palmer Activity Rating Scale 2.136 60
53 15. Total outdoor activity 2.204 50
53 16. Total indoor activity 2.047 60
53 17. Dispatch in eating lunch at school 26 min. 70
53 18. Freedom from colds 0 % 99.5
53 19. Freedom from illness 0 % 99.5
53 20. Hours in bed 11 hr. 7 min.
53 21. Hours asleep ---
53 22. Regularity of bed hour (S. D.) 15 min. 82
.. 23. Calories per lb. of body wt. .
.. 24. Protein, per lb. of body weight ..
.. 25. Fat, per lb. of body weight .
.. 26. Carbohydrate per lb. of body weight
48-53 27. Monroe Drawing Scale 1.8 45
53 28. Weight-height index .894 40
57 29. Goodenough test 6 points 30
30.
31.
32.
33.
34.
35.

FIG. 4. BIOGRAM OF CHILD 1-U (GIRL); BIRTHDATE: 1924–5–7; AGE (MONTHS): 53; SEPTEMBER 23–OCTOBER 22, 1928

shown no improvement in adjusting to the group socially, nor has she become less self-

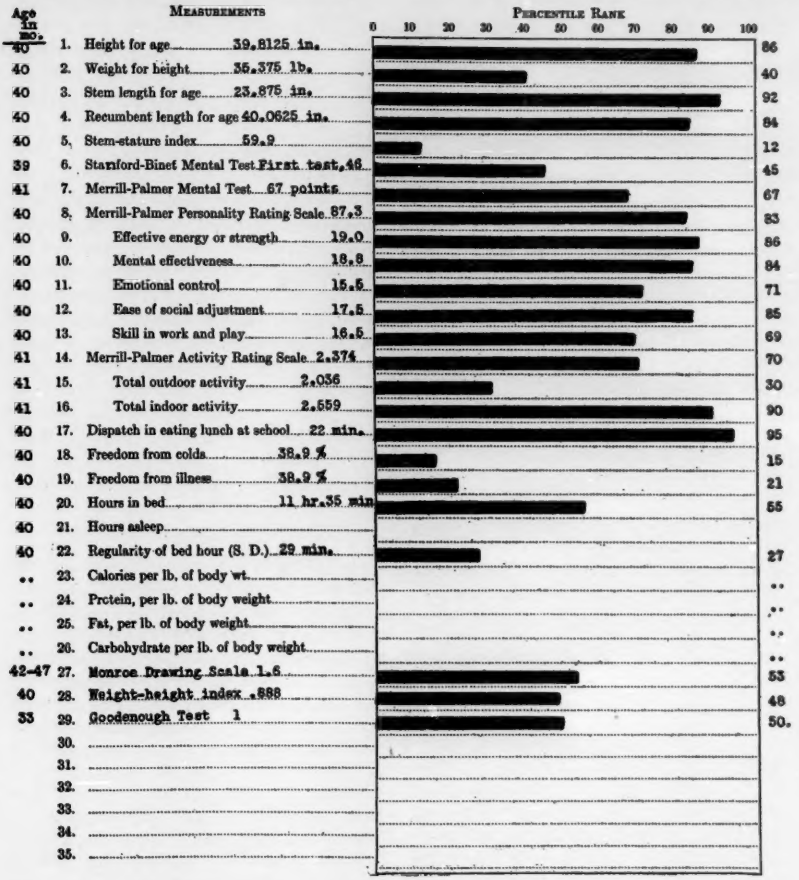
Age in Mo.
Measurements
Percentile Rank
0 10 20 30 40 50 60 70 80 90 100
40 1. Height for age 39.8125 in. 86
40 2. Weight for height 35.375 lb. 40
40 3. Stem length for age 23.875 in. 92
40 4. Recumbent length for age 40.0625 in. 84
40 5. Stem-stature index 59.9 12
39 6. Stanford-Binet Mental Test First test. 46 45
41 7. Merrill-Palmer Mental Test 67 points 67
40 8. Merrill-Palmer Personality Rating Scale 87.3 83
40 9. Effective energy or strength 19.0 86
40 10. Mental effectiveness 18.8 84
40 11. Emotional control 15.5 71
40 12. Ease of social adjustment 17.5 85
40 13. Skill in work and play 16.5 69
41 14. Merrill-Palmer Activity Rating Scale 2.374 70
41 15. Total outdoor activity 2.036 30
41 16. Total indoor activity 2.559 90
40 17. Dispatch in eating lunch at school 22 min. 95
40 18. Freedom from colds 38.9 % 15
40 19. Freedom from illness 38.9 % 21
40 20. Hours in bed 11 hr. 35 min 55
40 21. Hours asleep
40 22. Regularity of bed hour (S. D.) 29 min. 27
.. 23. Calories per lb. of body wt. ..
.. 24. Protein, per lb. of body weight ..
.. 25. Fat, per lb. of body weight ..
.. 26. Carbohydrate per lb. of body weight ..
42-47 27. Monroe Drawing Scale 1.6 53
40 28. Weight-height index .888 48
33 29. Goodenough Test 1 50.
30.
31.
32.
33.
34.
35.

FIG. 5. BIOGRAM OF CHILD 6-S (BOY); BIRTHDATE: 1925-7-18; AGE (MONTHS): 40; NOVEMBER 4–DECEMBER 3, 1929

ish. On the whole she is a most discouraging prospect.

III SPURIOUS CASES

Child 6-S (Fig. 5)

Physical. Charles is a ruddy-faced, slightly narrow-eyed child, with a noticeable twinkle and sparkle in his eye. He has a well-shaped body and head, attractive, well-shaped features, and well-formed, regular teeth. He is enthusiastic in activity, attacking projects impetuously. When he is excited his voice is likely to be shrill and too loud.

Mental. Charles's greatest sensory gift seems to be his fine perception of space,

shape, and size, for he handles vehicles and blocks accurately and constructively. He is often seen handling the edges of starched material, as if he enjoyed the tactual sensation. He is able to carry tunes only fairly well, but enjoys singing. He is not greatly interested in color and painting. He observes changes in the nursery school and is able to report all kinds of incidents which have happened to him away from the School. He enunciates clearly, has an excellent vocabulary, and uses fairly long sentences, but does not chatter and asks few questions. He is imaginatively constructive, as indicated by his many games of house, playing sea-lion or dog, and gas station. In one morning he dramatized being a storekeeper, a peddler selling cereal ("three for ten cents"), a man he knew, and a gas station attendant. He once built a garage with blocks and attempted to make a sliding door for it. His reasoning is excellent, as when he said of a picture of the Three Wise Men, "They are following the star," and when asked where they were following it, "To the hospital." He is very resourceful: at lunch one day when more cookies were needed at the serving table he took the plate without being told and walked to the kitchen and brought some back, though the children do not ordinarily go to the kitchen. Both in carrying out the building projects he has originated and in eating his dinner, he concentrates well; but at other times, especially when he is washing or dressing, he has continually to be watched or he runs off into another room to tease other children or the teacher. He has a childish sense of humor; he laughs at pictures of pigs, at the bathing of the bird, and so forth. He has a nervous habit of biting his nails or picking at his lips, a habit his mother says she herself has.

Personality traits. Charles is usually happy and cheerful, but he can be irritable, and though he is at times very rough with other children, he does not take buffeting from them with a good spirit. His affections are entirely normal; he does not seem emotionally dependent upon his parents or other adults, but kisses his mother goodbye willingly and often asks to be allowed to sit next to a particular nursery school teacher and is often gentle and helpful toward certain young children. On only one occasion has he shown any fear (a year after the Biogram was made), when one of the teachers remarked that he behaved as if he expected to be punished; however, he has called for a good deal of punishment for disobedience and disturbing the nap, and it would be strange if an intelligent boy of four had not learned when to expect punishment and to wince under the expectation. He is extremely belligerent—ready for a fight any minute when another child comes into his territory on the playground or interferes with him in any way—and according to a series of six weekly observations made by a student he had two fights every day. On the other hand, these temper outbursts are over quickly and he is constantly singing or laughing in pleasure over some activity he is carrying on. Though he shows no jealousy, he is distinctly antisocial where property is concerned; he wants what he wants when he wants it, and usually gets it by direct seizure. He is fond of being the leader but is so high-handed in his methods that he does not have much success in getting other children to work under his direction. Toward adults at the school he is negative, and only the teachers, who are there every day, can get coöperation from him; much of his negativism seems to be due to a desire for attention.

Habits. Charles has a splendid appetite and eats skillfully. He presents a distinct problem at naptime, for if permitted he will toss about, sit up, and make noise—anything to keep awake. He will get help in dressing if he possibly can and dawdles about washing. In general, he goes through the nursery school regime with a pugnacious spirit, either to gain attention or because he dislikes to do anything that does not suit him at the moment. In one respect he is averse to facing reality: when he does not get what he wants he pretends that it is not a desirable thing to have in any case.

Home environment. The parents are fairly prosperous. They like to have "a lot going on." They are intelligent, normal young persons. The father apparently teases his son a good deal.

Changes while in the nursery school. When Charles entered the nursery school at 2 years, 2 months of age, he was (as at present), hyperactive and impatient of any obstacle, whether a task in a mental test which he could not perform, or something he wanted which was in another's possession, or performing a duty when he preferred to be playing. He has always required constant praise if he were to continue a disagreeable task. He has developed somewhat in independence, seldom asking now for his mother when he is thwarted, though he still plays for attention in the nursery school by negativism. Though he has always been somewhat selfish, it must be said in justice that his selfishness is often followed by gentle care for a younger child. At present, a year after the making of the Biogram, Charles's qualities of leadership have improved so much that one of the nursery school teachers would place him among the ten most desirable children. In all probability child 10-D was given that place in the group, in preference to Charles, because of the difference in age. He also was negative to authority, but this quality was in a sense overridden by his leadership, while Charles, a younger child, had not yet developed his abilities in this direction, with the result that his negativism stood out as his chief characteristic.

SUMMARY

1. This study was undertaken in an attempt to test the efficiency of the Biogram, a graphic profile by means of which heterogeneous quantitative data concerning the individual child may be coordinated. At present it shows the child's ranking in 29 traits, data on which have been standardized and made comparable by means of the percentile method (14). The purpose of the Biogram is to furnish a graphic quantitative summary which will replace as far as possible the cumbersome and time-consuming qualitative summaries at present necessary in the child development centers. In its present form the Biogram is of course chiefly adapted to the records of the Merrill-Palmer School.

2. To determine what traits tended to differentiate relatively superior and inferior nursery school children, as determined by subjective choice, a comparative study was made of the Biograms of two groups of 10 children each, selected by 39 adults from among 43 children in the nursery school, the one as representing the most "desirable" children (the D group) and the other as representing the most "undesirable" children (the U group). A comparison of the percentile ranking and the median percentiles of the two groups showed considerable differences in the two groups as ranked by the Biogram. The trait that differentiated the two groups most was "effective energy," a term covering the child's rank in twenty statements representing one of five divisions of a personality rating scale. The D children were distinctly superior also in body weight, intelligence, and four personality items—mental effectiveness, emotional control, ease of social adjustment, and skill in work and play. The U children were found to have more regular bed hours than the D children; this was taken to mean that the parents of these children had adjusted their sleeping schedules to their health. The D group was superior to the U group in outdoor activity and dispatch in eating lunch. These results agree in general with those of Terman (11), who found that gifted children had general superiority, i.e., were taller, heavier, healthier, and more intelligent, than unselected

children are, and had better personality traits.

3. To determine how well the Biogram measures the quality of the "whole child," a method of totalling the Biogram ranks in single traits was worked out, and these totals were compared with the ranks given by the 39 judges. The two rankings showed a correlation of 0.82, indicating that the judges' opinions of the child's general quality and certain quantitative measurements of the child show a high degree of correspondence. It should be noted, however, that the correlation is higher than it would have been had all the quantitative measurements on the Biogram been used and given equal weight. A study of the cases in which the rank of the child on the Biogram and that given by the judges did not correspond showed that there are possibly two factors which go far toward making a child desirable in the eyes of an adult, but which are not measured by the Biogram in its present form; that is, coöperativeness (or response to authority—in this case, in the nursery school) and "social stimulus value" (5). A measure of these traits is now being constructed at the Merrill-Palmer School.

From the results of this study it may be concluded that even experts in child development are not competent to make truly objective judgments of children, and that a quantitative instrument, such as the Biogram, is needed to supplement and check their subjective judgments.

REFERENCES

(1) BOYD, EDITH: The experimental error inherent in measuring the growing human body. Oct.-Dec.,1929 American Journal of Physical Anthropology, Vol. XIII, No. 3, pp. 389–432.

(2) FRANZEN, RAYMOND: Physical measurements of growth and nutrition. 1929, School Health Research Monographs, No. II, New York: American Child Health Association, pp. xii + 138.

(3) GOODENOUGH, FLORENCE L.: *Measurement of Intelligence by Drawings.* 1926, Yonkers-on-Hudson, New York: World Book Co.

(4) HEJINIAN, LUCEA, AND HATT, ELISE: The stem-length: recumbent-length ratio as a measure of body type in young children. July–Sept., 1929, *American Journal of Physical Anthropology,* Vol. 13, No. 2, pp. 287–307.

(5) MAY, MARK A.: A comprehensive plan for measuring personality. 1930, Ninth International Congress of Psychology, *Proceedings and Papers.* Princeton, New Jersey: The Psychological Review Co.

(6) MONROE, MARION: The drawing and color preferences of young children. March, 1929. Unpublished Doctor's dissertation, The University of Chicago.

(7) ROBERTS, LYDIA J.: *Nutrition work with children.* 1927, Chicago: The University of Chicago Press, pp. xiv + 394.

(8) SIMS, V. M.: The measurement of socio-economic status. 1928, Bloomington, Illinois: The Public School Publishing Co., pp. 33.

(9) STUTSMAN, RACHEL: *Mental measurement of preschool children, with a guide for the administration of the Merrill-Palmer Scale.* Measurement and Adjustment Series, 1931, Yonkers-on-Hudson, New York: World Book Co., pp. x + 368.

(10) SWEENY, MARY E., HEJINIAN, LUCEA, AND SHOLLEY, REBECCA: A method for studying the activity of preschool children. September, 1929, *Journal of Home Economics*, Vol. 21, No. 9, pp. 671–8.

(11) TERMAN, LEWIS M., *et al.*: Genetic Studies of Genius. 1925, Vol. I, pp. xv + 648. Stanford University Press.

(12) TERMAN, LEWIS M.: The measurement of intelligence. 1916, Boston: The Houghton Mifflin Co., pp. xviii + 362.

(13) U. S. Bureau of Foreign and Domestic Commerce. *Statistical Abstract*. Washington, D. C., 1926.

(14) WILSON, CHARLES A.; SWEENY, MARY E.; STUTSMAN, RACHEL; CHESIRE, LEONEE; AND HATT, ELISE. The Merrill-Palmer standards of physical and mental growth. 1930, Detroit: The Merrill-Palmer School.

Eye and Hand Movements in the Training of Perception*

CHARLOTTE RICE

ALTHOUGH the allied fields of visual perception and manual motor coördination have been subject to no little experimentation and comment, so far as the author knows, there has been as yet no attempt to correlate the actual motor concomitants of eye and hand in an act of perception. Nor has anyone experimented with the effect the passive training of these concomitants might have on their form, and on the so-called efficiency of the perception act as it appears in the ability to reproduce or recognize the figure perceived. The experiment described in the present report, though exploratory in the extreme, and containing few, if any, positive results, is presented as a study in technique, in the hope that, as such, it may inspire someone to a further attack on the problem of the rôles played by eye and hand movements in perception.

* This experimental work was carried out while the author was the recipient of a National Research Fellowship in Child Development at the University of California in 1929–1930.

The author wishes to take this opportunity to thank Dr. Buford Johnson of The Johns Hopkins University for the idea leading to the research, Dr. Warner Brown and Dr. Harold E. Jones for their advice and criticism throughout, and Mrs. Maye P. Mudge of the Institute staff for her assistance in obtaining the subjects.

GENERAL PROCEDURE

In brief, the method pursued was as follows. On the first morning the subjects came to the laboratory, each one was shown 4 cards, bearing the figures respectively of a diamond, a square, a circle and a triangle. The figures were black outline drawings of considerable size—the square measured 8 inches to the side, and the others were in proportion. They were shown to the subject in succession for an exposure time of 10 seconds each, and after each exposure, the child was asked to go to a large drawing easel which stood in the corner of the room, and draw the figure he had just been looking at. While the child was looking at the cards a photographic record was taken of the actual eye movements made during the time of inspection. At the same time, the subject's hands and arms were resting in the slings of a Titchener automatograph, and a record was made of the slight hand and arm movements. These two records were synchronized in a manner later to be described. This procedure was followed by an orientation discrimination test in which one of the figures—the diamond—ap-

peared in various positions and was to be discriminated from a number of other figures presented simultaneously. The final test was one of tactual discrimination in which the child was given a diamond shaped block to feel, and was asked to pick out from the board any other blocks on which it seemed to fit. The blocks were screened from the child so that he had no way of seeing what he was doing.

After the first morning, the children returned to the laboratory once a week for 4 successive weeks. The first 3 weeks were devoted to practice, and on the final week the test procedure of the initial visit was repeated to determine what effect the 3 weeks of practice might have had on the activities measured at the outset. During the practice periods members of the first eye-training experimental group were presented with a stimulus in the form of a bright yellow knob designed to move around a diamond shaped path on a black board, and were requested to keep looking at the knob all the time, and to try to move their eyes as it moved. Each trial lasted 10 seconds, and after each trial, as a tangible objective, the child was asked to turn from the board and show the experimenter by moving his finger through the air, the way the knob moved. This was repeated 3 times each practice period, and there were 3 practice periods, making 9 trials in all. At each trial, the automatograph record of the hand movements was obtained, and at the first and last trials, a photographic record of the eye movements was taken, in order to detect the amount of direct practice effect obtained in the ability to follow a moving object with the eye. The control group meanwhile was put through the same procedure with the single exception that instead of looking at the moving stimulus, the subjects looked at the original card bearing the outline figure of the diamond. This was to obviate if possible the greater familiarity with the figure of the diamond on the part of the experimental group which would occur if the control group were kept free from all such stimulation during the practice period. In this manner all conditions could be kept approximately the same with the single exception of the practice in eye movement of a defined type which was experienced by the experimental group alone.

The practice periods for the second experimental group who were given hand-training were conducted in a similar fashion. But in this case the practice consisted in following the moving knob with the hand instead of the eye. The board was screened from the subject's view, and he was instructed to grasp the knob lightly, and move his hand along with it as it moved, thus following the pattern of the diamond path with his hand instead of his eyes. The trials again lasted 10 seconds, and were followed by the same ostensible objective—tracing in the air, for the experimenter to see, the path which the hand had previously taken while following the moving knob. A record was made, in each case, of the eye movements while the hand was following the knob, to compare with the automatograph records of the hand movements of the first experimental group. It was im-

possible to get a graphic record of any improvement which might occur in the ability to follow the knob with the hand. The only data here available were from the notes of the experimenter in which were recorded the subjects' apparent ease in doing the task set—his tendencies to jamb the mechanism, by pushing the knob, or by pulling it out of its socket, etc. The procedure of the control group was the same as that for the controls of the first experimental group.

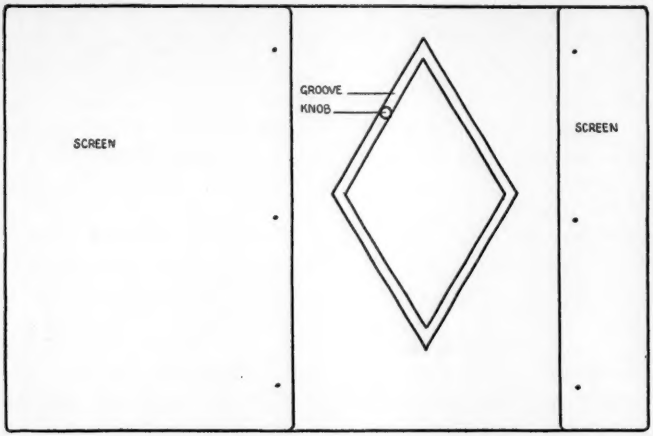

FIG. 1. STIMULUS DEVICE—SUBJECTS' VIEW

APPARATUS AND TECHNIQUE

Stimulus apparatus

As the stimulus apparatus appeared to the subject during the practice in eye movements, it consisted in a black surface, bearing, directly opposite the subject's line of gaze, a diamond outlined by a groove, around which moved a small yellow knob by means of a chain and sprocket wheel device. (See fig. 1.) Incidentally, the whole furnished a flat surface on which the stimulus cards used during the first and last days might be clipped. The subject, seated before the apparatus, looked at it through a hole in a screen. The observation hole was fitted with a head piece similar to that on the ordinary parlor stereoscope. This formed a closely fitting rim against which the head might be pressed and held practically immovable during the observation. A device for strapping the head to the head piece was devised but discarded. For the short time that the child had to look through the screen at one sitting, the directions of the experimenter together with the actual pressure of the rim served as an adequate stimulus for him to hold his head as motionless, at least, as he could be forced to do if he were strapped. The deleterious effect of

the confinement would in no way be offset by any rigidity that might be gained. It is foolish to expect from a child the same freedom from head movement which might be obtained from an adult, so rather than confine the child unduly, a method was devised for recording eye movements, by which any head movements occurring might be, to some extent, compensated for. Finally, the motive power for the stimulus apparatus was furnished by a motor and speed reducer connected to the sprocket wheel of the board by a pulley belt as is indicated in figure 2.

Recording apparatus

After the carefully controlled methods of recording eye movements devised first by Dodge (1) and Judd (4) it may appear as a step backwards to use such primitive methods as those about to be described. The impossibility, however, of confining a child too closely without a serious emotional upset, and of keeping a child's attention directed toward the stimulus apparatus while at the same time a beam of light is focused directly on the eye from the side, forces one, when dealing with children, to make the situation as natural as possible. For this reason, the reflection of natural daylight streaming through a single small window, and reflected on the cornea was taken as the point to be recorded. This was photographed from about thirty degrees to the side of the direct line between the subject

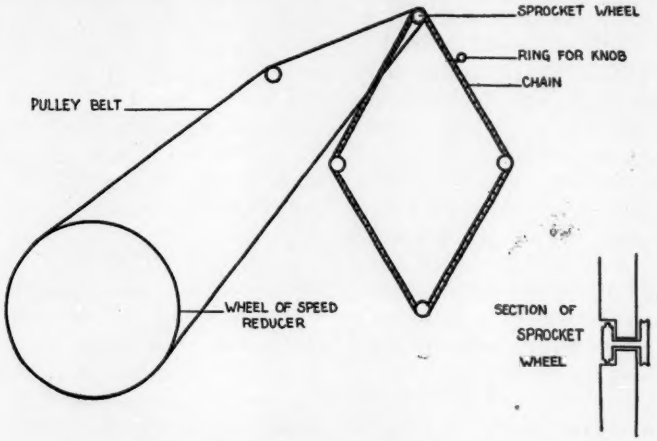

FIG. 2. STIMULUS DEVICE—MOTIVATING SET-UP

and the stimulus and from a distance of about two feet. Together with the light reflection from the cornea, was photographed the reflection from a bright lead bead fastened by means of a band to the center of the subject's forehead and showing distinctly through the observation hole whenever the subject looked at the stimulus object. This spot, moving as it did with the head, served as a reference point against which the spots obtained by photographing the reflection on the eye could be charted. The photographs were taken on 32 mm. film at the rate of 1 frame per second, as timed by a large seconds pendulum hanging behind the subject and in clear view of the experimenter. This speed by no means gave a complete record of the eye movements involved, but it was the highest speed practicable with the lighting conditions, and it furnished a fairly accurate picture of the general behavior of the eyes during the experiment.

In order to put the results in legible form, the photographic record was then projected on a screen, and the change in eye position from one frame to the next was recorded as carefully as possible by pricking with a pin through the exact center of the spots made by the reflection of the window on the cornea. These records were still too small for easy comparison, so the pricked card was now put into a projection machine, and the reflection thus produced was fixed on a larger card. By this process there were obtained easily legible records which could be quickly compared. Their only drawback was that they magnified any slight errors made in the first transcription.

The recording device for the hand movements consisted of 2 regular Titchener automatographs, reduced in size somewhat to be more suitable for the subjects, and with brass styluses substituted for the glass ones. In order to keep the subject's hand completely away from the stylus, a low protective partition was set against the inner side of the stylus carrier. These automatographs, suspended from the ceiling, furnished rests for both arms during the experiment. The record was taken on smoked paper under only one of the hands—the right in the case of right handed subjects, and the left in the case of left handed.

Synchronizing apparatus

There remains only to describe the manner in which the eye and hand records were synchronized so that they could be adequately compared. It has already been indicated in what manner the pictures of the eye reflection were timed. The pendulum by which this timing was accomplished was in circuit with a storage battery and the primary of an induction coil, and served as the make-break device for the whole. One terminal of the secondary coil was connected with the stylus of the automatograph, and the other with a brass plate on which the smoked paper for the automatograph record was fastened. The smoked paper acted as a spark gap, and by the insertion of a condenser in series with the secondary circuit, a sufficient spark was produced to obtain a spark

record of time on the smoked paper in conjunction with the record of arm movement. A diagram of the electrical connections appears in figure 3. In this manner, theoretically, there appeared for every frame on the photographic record, a spark on the smoked paper record, so that the eye and hand movements at a particular moment might be compared for similarities or differences. Actually, the spark record sometimes failed, so the synchronization was by no means absolute, but the result was sufficiently accurate to present a general indication of correspondence or lack of it.

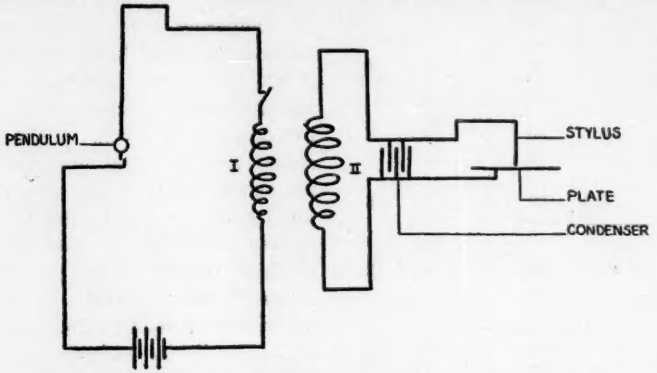

FIG. 3. ELECTRICAL SET-UP FOR SYNCHRONIZING APPARATUS

The subjects used in the experiment were ten pairs of twins which were obtained through the courtesy and effort of the Institute of Child Welfare at the University of California. The scarcity of twin pairs, from which to choose, made any choice on the basis of a home environment rating impossible. In general it may be stated that the home ratings stood slightly below the midpoint on a rating scale of 5—only two pairs receiving any ratings as high as 4, and none receiving any ratings as low as 1. A record of the ages, I.Q. ratings and similarities in physical appearance, interests and emotional traits for these subjects appears in table 1. In each case the individuals of a pair are arranged according to birth order. One of each pair was placed in the main experimental group, the other being used as its control. In the table, subjects in the experimental group are indicated by the initial letter A, while those in the control group are indicated by the letter B. The subjects were again divided according to the type of training those in the experimental group received. The first five received training in the eye movements concerned in perception, while the last five received training in hand movements. The small number of subjects was compensated for to a certain extent by the excellence of the manner of control used, and it was hoped that by a careful analysis of the results obtained on a small group like

this, a method of procedure might be worked out which would be fruitful when used on a more extensive scale.

TABLE 1

Supplementary data concerning subjects

Initial letters A and B signify Training and Control Groups respectively.

SUBJECTS	RATINGS OF SIMILARITIES—SCALE OF 5				
	C.A.	I.Q.	Physical appearance	Interests	Emotional traits
Eye training					
B 1	4:6	104	5	3	4
A 1		104			
A 2	5:3	96	2	4	3
B 2		96			
B 3	5:6	80	5	4	4
A 3		92			
B 4	5:9	93	5	5	5
A 4		89			
A 5	6:3	98	3	4	3
B 5		98			
Hand training					
A 6	5:0	102	2	3	2
B 6		95			
A 7	5:9	90	4	4	3
B 7		103			
A 8	6:3	115	2	3	2
B 8		101			
B 9	6:7	125	3	2	2
A 9		109			
A 10	7:10	110	5	4	5
B 10		108			

METHODS OF SCORING AND ANALYSIS

It would seem that a further careful revision of the technique, and a more accurate control of all the conditions would be necessary to justify an intricate evaluation of the data obtained. So far, all that has been desired is the detection of gross differences or similarities which might direct experimentation along some more specific line, and for that reason the judgment of similarities and differences—not by any involved system of points and scales, but by the mere judgment of gross correspondences,—has been the means of evaluation of the records of eye and hand movement. In comparing a set of eye or hand movements taken before the practice period with the corresponding set taken after the practice period, one of three scores was given. If the second record was strikingly more similar to the outline of the object viewed than the first one, + was recorded. If the reverse was true, − was recorded. If there seemed to be virtually no choice, 0 was recorded. In comparing the eye movements under a certain set of conditions with the synchronized hand movements under the same conditions, the record may be interpreted as follows. If there was no possible correspondence, − was recorded. If there was obvious correspondence, + was recorded. And where the issue was in doubt 0 was recorded.

The score record for the drawing of the 4 figures during the first day's test period was a far easier proposition. Here, however, the scaling had to be much more exact. With this in mind, the following system of scoring was devised for each of the four figures independently.

Diamond

Detail considered	*Highest score*
General form:	
Scribble	0
Enclosed space—no angles or Angular line—no closure	1
Enclosed space—1 angle	2
Enclosed space—2 angles, or more than 4 angles	3
Enclosed space—3 angles	4
Enclosed space—4 angles	5
Symmetry, proportion, balance, etc.:	
Vertical angles aligned	1
Horizontal angles aligned	1
Top equal to bottom	1
Right equal to left	1
Angular relations accurate	½
Execution of lines and angles true	½
Total possible points per person.	10

Square

General form:	
Scribble	0
Enclosed space—no angles or Angular line—no closure	1
Enclosed space—1 angle	2
Enclosed space—2 angles, or more than 4 angles	3
Enclosed space—3 angles	4
Enclosed space—4 angles	5
Symmetry, proportion, balance, etc.:	
Vertical sides equal	1
Horizontal sides equal	1
One vertical equals one horizontal side	1
The other vertical and horizontal sides equal	1
All angles right angles	½
Execution of lines and angles true	½
Total possible points per person.	10

Circle

General form:	
Scribble	0
Enclosed space—no approximation to circle	1
Circle	5
Symmetry, proportion, balance. etc.:	
Top balances bottom	1
Right balances left	1
Vertical and horizontal diameters equal	2
Outline well joined	½
Execution of line true	½
Total possible points per person.	10

Triangle

General form:	
Scribble	0
Enclosed space—no angles or Angular line—no closure	1
Enclosed space—1 angle	2
Enclosed space—2 angles, or more than 2 angles	3
Enclosed space—3 angles	4
Enclosed space—3 angles, base at bottom	5
Symmetry, proportion, balance, etc.:	
Right and left symmetry	2
Equality of sides	2
Angles clearly defined	½
Execution of lines true	½
Total possible points per person.	10

By using this scoring system, and examining the data for any consistent differences between scores at different times, any effect which the practice period might or might not have had upon the execution of the forms could be determined.

The scoring of the orientation perception test was similar to a method already devised and standardized to a certain extent in a previous experiment (5). Similar changes in score could thus be noted, and their significance determined.

The test of tactual discrimination was one newly devised, and as yet, unstandardized. Performance on it was scored arbitrarily as follows:

Performance type	*Score*
All blocks chosen	0
No blocks chosen	0
One diamond block chosen	+7
Two diamond blocks chosen	+10
Triangular block chosen	−1½
Square block chosen	−1½
Circular block chosen	−7

Thus, the choice of one diamond block could be completely vitiated by the choice also of the circular block, while it would be only partially vitiated by the choice also of the triangular block. In this way an attempt was made to weight the closeness of the discrimination displayed.

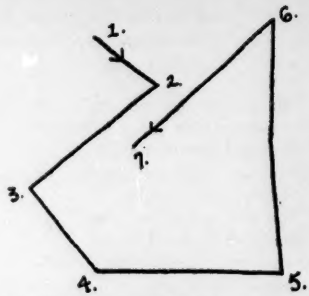

FIG. 4. PATTERN OF EYE MOVEMENT—EXAMPLE OF EXTREME CORRESPONDENCE BETWEEN EYE MOVEMENT AND FIGURE FORM

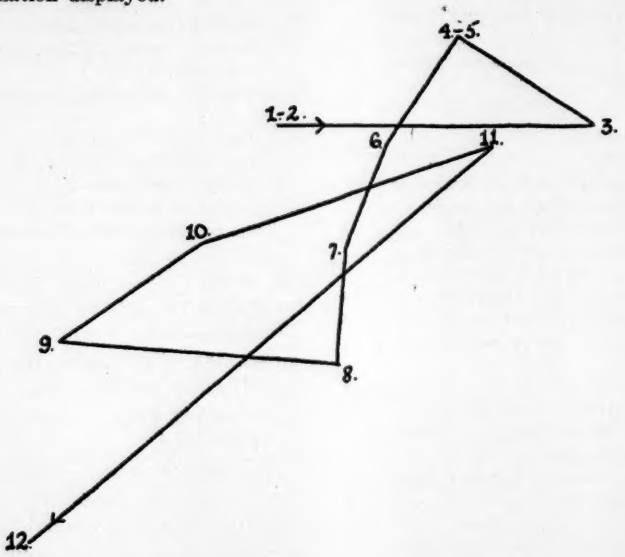

FIG. 5. PATTERN OF EYE MOVEMENT—EXAMPLE OF FAIR CORRESPONDENCE BETWEEN EYE MOVEMENT AND FIGURE FORM

RESULTS

1. First, was there any practice effect in the specific tasks practiced? In the case of eye training any such effect would be evident from an increased tendency for the record of eye movement to follow a pattern corresponding to that followed by the moving stimulus. A survey of the records

taken for the first practice of the first practice period as compared with those of the third practice of the third practice period shows that such an increase in similarity is present to a certain extent in all five subjects. In one case the record of the final practice is an extreme example of correspondence. (See fig. 4.) The other four cases, of which figure 5 is an example, combine such correspondence with the tendency to shift the eyes toward the experimenter from time to time, but in all cases, there is a distinct gain in correspondence by the last practice over the first.

For the hand training, no similar record was possible. It may simply be stated from the recorded observation of the experimenter, that in every case the manipulation of the moving knob did improve to a marked extent between the first and last practices with regard to such details as holding the knob lightly so that it would not become jambed in the groove, or so that it wouldn't be pulled from its carrying ring. In short, the subjects learned "to ride" the knob successfully within the time allotted for practice. To a considerable extent, then, the two practice procedures were hardly equivalent, for at the end of the three periods of training the pursuit movement of the eye was in most cases only partly learned, while that of the hand was completely learned. What would have happened to the results had the eye movement been more completely learned cannot even be surmised. In an attempt to keep the practice well below that which would condition the eye movement to merely looking through the screen, regardless of what was to be seen on the other side, the practice time was evidently reduced too much. But, on the other hand, the practicability of working longer with children of this age without incorporating rewards of such strength as to vitiate the results was questionable. That they were sufficiently developed physically and intellectually to succeed is obvious from the results. That they were not yet sufficiently stable emotionally to work a longer time at this rather monotonous task without some greater reward than they were getting was obvious to the experimenter from their conduct during the last practice periods. Aside from this factor, the mere bother which the parents experienced from the five weekly trips to the laboratory was not to be reckoned with too lightly. Leaving for the moment the extent to which the two movements were learned respectively, the fact remains that they were learned in part at least. And to the extent to which they were learned, the practice was effective in the specific task.

2. It remains next to be determined whether the practice was in any way effective in the related activity of looking at an outline figure of the path traced by the moving stimulus. To begin with the eye—if the practice were in any way effective in changing the way in which the eye moved during the time of regarding the outline figure of the diamond, we should expect to find consistant differences between the records of eye movements taken before the practice in eye movement, and those taken after the practice

period, characterized by a greater similarity of the latter to the outline form under consideration. Further, we should expect to find no such differences between the corresponding records made by the control group which had undergone no practice. A glance at the first column of table 2 would indicate that this difference appears surely in only one case of the five in the practice group. That it does not appear at all in the control group, and in one case actually reverses, is not enough to add the needed significance to the results of the practice group. Further, if no carry over effect is in evidence with regard to the form on which the practice occurred, it is rather needless to expect any such effect with regard to the other forms of the test. If we look at the other three columns of table 2, we find similar results to those appearing in the first column. The differences which do occur are scattered rather evenly between the practice group and the control group and nowhere show a trend consistent with an hypothesis of transfer. Finally, in the face of this, we would hardly expect to find positive results from the group subjected to the hand movement training. A glance at table 3 is convincing of the fact that the results here are as definitely negative as those in table 2.

TABLE 2

Results of comparison of eye movements before and after eye movement training

SUBJECTS	DIAMOND	SQUARE	CIRCLE	TRIANGLE
A1	0	0	0	0
B1	−	+	0	0
A2	+	0	+	0
B2	0	CL	CL	CL
A3	0	0	+	0
B3	0	0	−	0
A4	0	0	+	−
B4	0	+	+	0
A5	0	0	0	0
B5	0	0	+	0

(CL signifies that due to incomplete data the comparison is lacking.)

TABLE 3

Results of comparison of eye movements before and after hand movement training

SUBJECTS	DIAMOND	SQUARE	CIRCLE	TRIANGLE
A 6	0	0	0	0
B 6	0	0	0	0
A 7	+	0	0	0
B 7	0	0	0	0
A 8	0	0	0	0
B 8	−	0	0	0
A 9	+	0	0	0
B 9	0	0	0	CL
A10	−	+	0	0
B10	0	0	CL	−

3. The records of hand movement taken before and after the training in hand movement given in table 4 show that here again, there is no evidence of significant effects. In fact there is even less evidence of an effect here than there was for training in eye movement, in spite of the fact that the learning during the practice in hand movement was apparently more complete than that during the practice in eye movement. The difference in the results shown in the two tables

is slight and may rather be laid to a difference in the type of chance variations of the two activities than to a difference in the transfer of any practice effect. Finally, we learn from table 5 that there is no evidence that training in eye movement effects a change in the automatic hand movements during observation.

4. With no evidences of transfer apparent in the more closely allied activities, it would seem hardly worth while to look for any in the more remotely allied activities of drawing, orientation discrimination, and tactual discrimination. The extremely specific nature of the activities discussed so far might, however, preclude any effect on them by the particular training undergone, while such an effect would show itself in a more remotely connected, but less specific activity. Turning to the results on the drawing tests, in which the child was asked to draw from memory the figure he had just been observing, we will find them fully indicated in table 6. Inspecting the lines marked "Totals," and "II-I," we find the following facts indicated. For the subjects subjected to the eye-movement training, four out of five of the experimental group gained more points from the first to the second execution of this test than did the corresponding members of the control group. For the subjects subjected to the hand-movement training, the same was true for two out of the five. Two of these apparent gains, however,—one from each group—were in reality merely cases in which both the experimental and the control subjects had lost points from the first to the second test, and the loss by the experimental subject was somewhat less than that by the control. These data would indicate only a bare possibility of some transfer of

TABLE 4

Results of comparison of hand movements before and after hand movement training

SUBJECTS	DIAMOND	SQUARE	CIRCLE	TRIANGLE
A 6	0	0	0	0
B 6	CL	0	0	0
A 7	CL	0	0	0
B 7	0	0	0	0
A 8	0	0	0	0
B 8	0	0	0	0
A 9	0	0	CL	0
B 9	0	0	0	0
A10	0	0	0	0
B10	0	0	0	0

TABLE 5

Results of comparison of hand movements before and after eye movement training

SUBJECTS	DIAMOND	SQUARE	CIRCLE	TRIANGLE
A1	0	0	0	0
B1	0	0	CL	0
A2	0	+	0	0
B2	0	0	0	0
A3	+	0	0	0
B3	0	0	0	0
A4	0	0	0	0
B4	+	0	0	0
A5	0	0	0	0
B5	0	0	0	0

TABLE 6a

Results from drawing of figures—Eye trained group

	SUBJECTS																			
	A1		B1		A2		B2		A3		B3		A4		B4		A5		B5	
	Test time																			
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Diamond:																				
Form	1	4	5	1	4	4	1	4	5	3	4	1	5	5	5	5	5	5	5	5
V. angles										1		1	1	1	1	1	1	1	1	
H. angles	1	1			1	1		1			1			1				1		1
Top-Bottom														1				1		
Right-Left	1		1		1	1		1		1	1				1	1	1	1	1	1
Execution		½	½		½	½	½	½			½		½		½	½	½	½		½
Totals	3	5½	6½	1	6½	6½	1½	6½	5	5	6½	1	6½	8	7½	7½	7½	9½	7	7½
II−I	2½		−5½		0		5		0		−5½		1½		0		2		½	
Square:																				
Form	1	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5
V. sides	1	1			1	1		1	1				1	1	1	1	1	1	1	
H. sides		1	1		1	1		1							1	1	1			1
V. and H. T.							1						1					1		1
V. and H. B.	1			1										1					1	
Execution	½	½	½		½	½	½	½	½				½	½	½	½	½		½	½
Totals	3½	7½	6½	6	7½	7½	6½	7½	6½	3	5	5	7½	7½	7½	7½	7½	7	7½	7½
II−I	4		−½		0		1		−3½		0		0		0		−½		0	
Circle:																				
Form	5	5	3	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5
Top-Bottom		1				1	1		1	1					1	1		1	1	
Right-Left	1					1									1	1	1	1	1	
Equ. Diam.			2	1	1	2		1			2	2	1	2	2	1	2	2		2
Execution	½		½	½	½	½	½	½		½	½	½	½		1	½	½		½	½
Totals	6½	6	5½	6½	6½	9½	6½	6½	5	6½	7½	7½	6½	7	10	8½	8½	9	7½	7½
II−I	−½		1		3		0		1½		0		½		−1½		½		0	
Triangle:																				
Form	4	5	3	3	5	5	5	5	4	5	1	3	5	5	5	5	5	5	5	5
R-L sym.					2	1		2	2	1			2	2	2	1	2	2	2	2
Equal sides	2				2	1								1				2		
Execution	½	½				½	½	1					½	½	½	½	½	½	½	½
Totals	6½	5½	3	3	9	7½	5½	8	6	6	1	3	7½	8½	7½	6½	7½	9½	7½	7½
II−I	−1		0		−1½		2½		0		2		1		−1		2		0	
Total gain or loss, II−.I.	5		−5		1½		8½		−1½		−3½		3		−2½		4		½	

TABLE 6b

Results from drawing of figures—Hand trained group

	SUBJECTS																			
	A6		B6		A7		B7		A8		B8		A9		B9		A10		B10	
	Test time																			
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Diamond:																				
Form	4	5	0	4	5	5	5	5	5	5	5	5	5	5	5	5	3	3	5	5
V. angles		1			1	1		1	1		1	1	1	1	1	1		1	1	1
H. angles	1						1		1							1	1	1	1	1
Top-Bottom		½				1	1				1	1	1		1	1			1	
Right-Left	1	½			1			1	1	1			1	1	1				1	1
Execution	½	½			½	½	½	½	½	½	½	½	½	½	½	½	½		½	½
Totals	6½	7½	0	4	7½	7½	7½	7½	8½	6½	7½	7½	8½	7½	8½	8½	4½	5	9½	8½
II−I	1		4		0		0		−2		0		−1		0		½		−1	
Square:																				
Form	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
V. sides		1	1	1	1		1			1	1	1	1	1	1		1		1	1
H. sides		1	1	1	1	1		1		1		1	1		1	1	1	1	1	1
V. and H. T.	1		1	1				1	1		1				1					1
V. and H. B.	1		1	1		1	1		1					1	1	1				1
Execution	½	½	½	½	½	½	½	½	½	½	½	½	½	½	1	½	½	½	½	
Totals	7½	7½	9½	9½	7½	7½	7½	7½	7½	7½	7½	7½	7½	7½	10	7½	7½	6½	7½	9
II−I	0		0		0		0		0		0		0		−2½		−1		1½	
Circle:																				
Form	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Top-Bottom		1	1		1		1	1	1	1				1			1	1		
Right-Left		1	1	1	1		1	1	1	1				1	1		1	1		
Equ. Diam.				1		2					2	1	2			2		2	2	2
Execution	½	½	½	½	½	½	½	½	1	½	½	½	½	½	½	½	½		½	½
Totals	5½	7½	7½	7½	7½	7½	7½	7½	8	7½	7½	6½	7½	7½	6½	7½	7½	9	7½	7½
II−I	2		0		0		0		−½		−1		0		1		1½		0	
Triangle:																				
Form	5	5	3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
R-L sym.	2	2	1	1	1	2	1	2	2	2	2	2	2	2	1	1	2	2	1	1
Equal sides		1			1	1			2	2	2	2	1		1				1	1
Execution	½	½		½	½	½	½	½	1	1		½		1	½	½	½	½	½	½
Totals	7½	8½	4	4½	7½	8½	6½	7½	10	10	9	9½	8	8	7½	6½	7½	7½	7½	7½
II−I	1		½		1		1		0		½		0		−1		0		0	
Total gain or loss, II−I	4		4½		1		1		−2½		−½		−1		−2½		1		½	

TABLE 7

Gains in score on drawing test related to I.Q. ratings

	HIGHER I.Q. GAINS	HIGHER I.Q. LOSSES
Frequency—total	2	4
Eye training	1	1
Hand training	1	3

TABLE 8

Results from orientation discrimination test

SUBJECTS	TEST TIME		
	I	II	II–I
A 1	4	3	−1
B 1	4	4	0
A 2	6	6	0
B 2	3	4	1
A 3	4	4	0
B 3	4	4	0
A 4	4	4	0
B 4	3	4	1
A 5	4	5	1
B 5	4	6	2
A 6	4	4	0
B 6	4	4	0
A 7	4	6	2
B 7	4	4	0
A 8	6	6	0
B 8	6	5	−1
A 9	4	5	1
B 9	6	6	0
A10	4	4	0
B10	4	4	0

the practice effect in the group subjected to eye training. The only other factor which would seem likely to effect the scores in this way is that of the I.Q. ratings, which it will be recalled, by reference to table 1, were not the same for the two twins of a pair in all cases. But a hasty glance at table 7 will show that if there is a relation here it is inverse. The more logical conclusion would be to assume a slight, but uncertain transfer effect.

TABLE 9

Results from tactual discrimination test

SUBJECTS	TEST TIME		
	I	II	II–I
A 1	0	3	3
B 1	0	0	0
A 2	7	0	−7
B 2	0	7	7
A 3	0	4½	4½
B 3	0	0	0
A 4	0	0	0
B 4	0	0	0
A 5	0	7	7
B 5	8½	10	1½
A 6	0	0	0
B 6	10	8½	−1½
A 7	7	10	3
B 7	8½	5½	−3
A 8	0	7	7
B 8	7	7	0
A 9	0	0	0
B 9	7	7	0
A10	7	10	3
B10	7	10	3

A survey of the results on the other two tests as they appear in tables 8 and 9, shows them to be very erratic. The scoring on these two tests was in-

sufficiently standardized, and only serviceable if one wished to trace through the activities of a particular case in the records. There may be a very slight transfer effect indicated in the test of tactual discrimination. No such effect is deducible from that of orientation discrimination.

5. From tables 10 and 11 it may readily be gathered that any attempt to discover a carry over effect of the directed activity of the hand into the random activity of the eye, and vice versa, has again led to only negative results. Even during the practice periods (table 10) when the tension of the subject might be expected to call forth such an effect, there is almost no positive evidence of its presence. In some cases, the hand movement ceased almost entirely during the observation, but not always. More frequently the hand line was already moving in a general direction, or manner, and merely continued to do so without interruption. In any case, there appears to be almost no correspondence between the direction of its movement and that of the eyes at the same time.

6. Finally, an attempt to divide the patterns of eye and hand movements into specific types met with little success. Any types which did occur seemed dependent on the conditions of the moment rather than on a degree or type of development, and were so scattered that they were useless in determining any progressive change in type of eye or hand movement.

TABLE 10

Correspondence between eye and hand movements during practice periods

Practice in eye movement

SUBJECT	PERIOD	
	First period—first practice	Last period—last practice
A1	–	–
A2	–	–
A3	–	–
A4	–	0
A5	0	–

Practice in hand movement

SUBJECT	PERIOD								
	First			Second			Third		
	1st practice	2nd practice	3rd practice	1st practice	2nd practice	3rd practice	1st practice	2nd practice	3rd practice
A6	0	–	0	–	0	–	–	–	0
A7	–	–	–	CL	CL	CL	0	0	0
A8	–	–	–	0	0	–	0	0	–
A9	–	CL	0	0	0	0	0	+	–
A10	0	0	–	–	–	–	–	–	0

TABLE 11

Correspondence between eye and hand movements during observation periods

SUBJECT	FIGURE OBSERVED							
	Diamond		Square		Circle		Triangle	
	Period I	Period II	Period I	Period II	Period I	Period II	Period I	Period II
A 1	–	–	0	–	–	0	–	–
B 1	–	–	–	0	CL	–	–	–
A 2	0	–	–	–	CL	–	–	–
B 2	0	–	–	CL	–	CL	–	CL
A 3	–	–	–	0	–	–	–	–
B 3	+	–	0	–	0	–	–	–
A 4	–	–	–	0	–	0	0	–
B 4	–	–	–	0	0	–	–	–
A 5	–	0	–	0	–	+	–	–
B 5	–	–	–	–	–	–	0	–
A 6	–	–	–	0	–	–	–	–
B 6	CL	–	–	–	–	–	–	0
A 7	CL	–	–	–	–	–	0	CL
B 7	–	–	–	–	–	0	–	0
A 8	–	–	–	–	0	–	–	–
B 8	–	–	–	0	0	–	–	–
A 9	–	–	–	–	–	–	0	–
B 9	–	–	–	–	–	–	–	CL
A10	–	–	–	–	0	–	–	0
B10	–	–	–	0	–	CL	–	–

SUMMARY AND SIGNIFICANCE OF RESULTS

From these records it was hoped that some of the following facts might be obtained.

1. In the first place, a comparison of the records at the beginning with those at the end of the practice period would show any improvement in the specific ability practiced.

2. A comparison of the eye movements pursued in observing the figures on the cards before the practice period, with those pursued after, would indicate whether or not any incorporation of the learned movements had been made in the mere mechanics of observation.

3. A similar comparison of the automatic hand movements before and after practice would indicate any transfer in this direction.

4. If any observable effect of the

practice were evident under either 2 or 3, a comparison of the type, direction and extent of such effects would bear directly on the question of the relative importance of the parts played by hand and eye movements in perception.

5. Any differences present in the experimental group and absent in the control group, between the execution, before and after the practice period, of the more remotely connected tests, such as drawing of the figures, orientation discrimination, and tactual discrimination, would indicate any effect which the practice would have had upon these allied types of manual-motor coördination and perception.

6. A careful inspection of the synchronized records of hand and eye movement during any one act of observation or practice would indicate any carry over effect of the directed activity of the one into the random activity of the other.

7. Finally, if the patterns of eye and hand movements are found to divide themselves naturally into specific types, a comparison of these types with the execution of the tests made during the first and the last periods at the laboratory would indicate any progressive change in type of eye or hand movement paralleling a developmental change in perception and manual-motor coördination as measured by these tests.

Under the conditions of the experiment we have found no transfer effect of any kind from imposed practice of eye and hand movements on eye and hand movements of an unrestrained nature used during observation of plane figures. Nor have we found, from the inspection of the synchronized records of hand and eye movement during observation, or practice, any carry over effect of the directed activity of the one into the random activity of the other. We have found a definite practice effect in the specific activity undertaken during the practice periods, and a possible transfer effect of this practice on the rather indefinitely defined activity of drawing the figure observed. In the light of the very scant positive results, what is the significance of the overwhelming negative results?

Either the amount of practice was insufficient,—a fact which could be ascertained by training through a longer and more intense practice to a greater degree of learning,—or the type of training was inadequate, i.e., it was not of a type to produce such results. The experimenter is inclined toward the latter explanation. It seems to fit in with previous experiments on transfer of the practice effect of specific motor activities to those of a less specific and more highly integrated nature. Especially interesting in this connection is a comparison with the experiments of Gates and Taylor (2) and Hertzberg (3) on the motor economy factors involved in teaching beginners to write, in which they found very little carry over effect from practice on a variety of forms of tracing to the actual task of writing.

If on the other hand the results of the drawing test do show a real effect from the practice, we must limit our statement to the fact that while there is a transfer effect of some sort, it does not work through the channels of eye or hand movement, but is due rather

to an increased alertness to the details of the figure during the practice period, due perhaps to the imposed motor activity, perhaps to something else, but certainly not detectable within the confines of the experimental procedure here indicated.

That some sort of eye-hand coördination is necessary for such a culmination of the perception process as the drawing of a figure from a model or from memory is self evident. That this is a relatively slow developmental process is also fairly well indicated, as well as the facts that certain people eventually are able to accomplish it better than others, and that some never do learn it adequately. An attempt has been made to ascertain just how this development takes place. It has failed. But it is hoped that the mere account of the failure may give a cue by which the problem will eventually be solved.

REFERENCES

(1) DODGE, R., AND CLINE, T. S.: The angle velocity of eye movement. Psych. Rev., 1901, **8**, pp. 145–157.

(2) GATES, A. I., AND TAYLOR, G. A.: The acquisition of motor control in writing by preschool children. Teach. Col. Rec., 1923, **24**, pp. 459–469.

(3) HERTZBERG, O. E.: A comparative study of different methods used in teaching beginners to write. Teach. Col. Contrib. to Educ., No. 214, 1926.

(4) JUDD, MCALLISTER AND STEELE: General introduction to a series of studies of eye movements by means of kinetoscopic photographs. Psych. Rev. Mon. Suppl., 1905, **7**, No. 29.

(5) RICE, C.: The orientation of plane figures as a factor in their perception by children. Child Dev., 1930, **1**, pp. 111–143.

Differential Skeletal Maturation in Relation to Sex, Race, Variability and Disease

T. Wingate Todd

The need for a comprehensive view of child development

In TWO of my recent papers upon the roentgenographic study of skeletal differentiation I have described the successive stages of epiphysial maturation and union (19) and have given a quite general sketch of the phenomena checked against age as identified in the skeletons of white boys (20). So far I have left entirely untouched the problems of sex, race, local conditions of life, individual variability, correlation with other measures of development, and the devastations produced by disease. These problems are too large for adequate treatment within the limits of a single essay and I shall be content if, out of the enormous mass of data gathered during the past decade, some salient facts can be marshalled to indicate the manner in which all these problems must be viewed if we are to build a constructive interpretation of what at first appears to be a maze of conflicting observations.

It is true that we meet with different types of human form defined by a myriad of names but conveniently classified in their extreme degree as asthenic, athletic and pyknic. By whatever terms we name these and however we subdivide and classify the connecting forms, we emphasize merely superficial distinctions: there is no fundamental difference (16). Mankind in his physical growth and ultimate pattern obeys certain essential and deeply rooted laws of mammalian anatomy from which, under conditions of health and soundness of body, there is no appeal. Among these are the order and date of epiphysial differentiation and union. In recent years many loose, vague and partial observations have been recorded concerning the problem of the epiphyses by workers, honest enough, but lacking breadth of experience and understanding of the principles illustrated by the phenomena which they have tried in vain to interpret. A roentgenographic study unchecked by examination of the naked bones themselves will lead us astray (18). An interpretation of human epiphysial union uncontrolled by understanding of the mammalian pattern is like exploration of a strange city without a map to guide us (18). The assumption of a "natural" variability implies a failure to study the conditions under which divergencies from pattern are

brought about. And lastly the insistence on a fundamental distinction between the sexes bespeaks a mind which still conceives man and woman as different creatures rather than manifestations of a single plan. It is not usually claimed that the actual order is different for the two sexes but that in the female there is an acceleration of increasing velocity as the years of childhood pass into those of youth. One inquires where, in life, this curious acceleration stops. And when, under my direction, Stevenson pointed out that it could not be invoked beyond the entrance to adulthood, namely the years eighteen to twenty-two (13), numerous critics arose to expose our mistake. We made no mistake and, refraining from entering into a controversy which would leave the problem still unsettled, we have patiently continued to amass our evidence which is now ready for public examination.

THE RELATION OF SEX TO SKELETAL MATURATION

In two earlier essays I have dealt briefly with the topic of sex in relation to skeletal differentiation (15, 17) but in this review it is necessary to consider the problem a little more closely. It is stated that girls mature in their skeleton earlier than boys, at first by days, then by months, then years (10). I have no quarrel with Doctor Pryor's observations so far as they go, save that I would remind the reader, as Pryor has done, of the necessity, in this as in all observations on human growth, to check the age-records. Hospital statements of age as found on routine roentgenograms are, in our experience, frequently fallacious. In America an error of a year or two is not uncommon in children and in adults we find the error covering five to ten years. Nothing short of the birth certificate can satisfactorily establish the age record, a precaution which would be taken as a matter of course in experimental work on animals. The ill-substantiated evidence on which the tables of union in recent anatomical texts is based has already been discussed (19, 20). Dwight's account alone bears intrinsic evidence of an original investigation but that is clearly limited to the limbs excluding hand and foot (6). Epiphysial union may be set aside for the moment in favor of centers of ossification.

It has been set forth again and again, with a wealth of thoroughly substantiated evidence that ossein is precipitated in the cartilaginous skeleton of girls at an earlier age than in boys. Pryor has demonstrated it (10) and since his first observations in 1905 many observers of equal integrity and assiduity have confirmed the observation. I refer but to two of the most recent (12, 1) as examples. There is no disposition on our part to disagree. The contention is fully admitted. But at the same time one must realize that the inception of ossification in a cartilaginous epiphysis and the union of the bony epiphysis into which that cartilage is eventually transformed are two quite different phenomena, separated in most instances by many years. To insist that both must necessarily be inseparably linked phases of the same phenomenon requires a strong imagination and is devoid of proof. The

date of earliest ossific penetration is itself so liable to variation from a host of causes, for the most part quite obscure, that the precise significance of the earlier appearance in the female requires much further study for its elucidation. Meantime let us not drag it into the problem of epiphysial union with which, at best it can be but remotely connected.

So far as the actual demonstrable evidence in our qualitative study of a sample thousand school children, backed by skeletal dissection, is concerned the ascertained facts are those of succeeding paragraphs.

TABLE 1

Female accelerated over male in skeletal differentiation by months as below

AGE	KNEE	HAND	ELBOW
5-0 – 5-5	6	0	0
5-6 – 5-11	6	0	0
6-0 – 6-5	6	6	0
6-6 – 6-11	12	6	0
7-0 – 7-5	15	6	0
7-6 – 7-11	12	6	0
8-0 – 8-5	9	6	15
8-6 – 8-11	12	4	9
9-0 – 9-5	6	0	6
9-6 – 9-11	18	0	6
10-0 – 10-5	18	12	24
10-6 – 10-11	24	15	24
11-0 – 11-5	18	18	18
11-6 – 11-11	12	12	12
12-0 – 12-5	12	12	9
12-6 – 12-11	6	4	24

In table 1 are drawn up the analysis of our observations upon the male and female white school children between five and thirteen years. During this period of course the estimation of age is based upon differentiation of the ossifying epiphyses and shafts.

The knee, it will be seen, maintains an ascendency in the female. While this acceleration of female over male is usually twelve months or more it drops to three times the standard deviation as worked out by Hellman (which is three months (9)) or less from five to six and a half years, about nine years and again at twelve and a half. This considerable and moderately steady female acceleration is a little difficult to interpret. However we have made a careful study of the relationship of knee differentiation to stature and find the linkage closer than with hand or elbow. We might therefore consider stature as a percentage of full adult stature, which is reached by our girls at about fifteen and a half years, rather than as a measure in absolute millimeters. The ultimate stature of the boys is far greater than that of the girls and moreover continues to rise until about seventeen years on the average. Mr. Bowman in this laboratory has shown that there is a close correlation in the adult between arm length and leg length (17) but we do not find an acceleration in elbow differentiation of the female comparable with that of the knee until after ten years. The adult female hand is small both in absolute and in relative dimensions but again there is no such acceleration in hand as there is in knee. The explanation is probably to be sought in a combination of these factors and further investigation is required.

In the table there are irregularities of relationship such as would be bound to occur in any series and are intrinsic evidence of probable reliability. The samples in general number twenty to twenty-five for each sex in each six-

month period. The sudden great leap ahead of the girls in elbow maturation between twelve and a half and thirteen years is of course due to the commencement of union.

Despite all statements colored by inception of ossification, the observations of Dodge (5) show that there is increasing uniformity of bodily weight during the first eighteen months of life and the Misses Hejinian and Hatt have shown the relative stability of bodily dimension between one and five years (8). That skeletal development bears an intimate relationship to bodily growth has been demonstrated by Scammon (12). Setting on one side the equivocations of earliest ossific penetration as a phenomenon more obvious than significant, the relative uniformity of skeletal differentiation at about five years in both males and females is gradually departed from owing to progressive acceleration in the female. This sex difference increases until a general high level is reached at about eight years. There then appears a flagging in female differentiation which permits the males to catch up so that by nine years the sex difference is very small. After the tenth birthday there in another spurt of acceleration in the girls which shows distinct signs of failing before the thirteenth birthday. After this date the commencement of epiphysial union, related as it is to cessation of growth in dimensions, alters our criteria and brings us to a second phase in the study of skeletal maturation.

From thirteen years upward our standards are far less general in character than before. They are different in type and depend upon local manifestations of completion of growth. They emphasize features of the skeleton quite different from those of the preceding phase.

In table 2 are arranged the relationships of the sexes judged by these new criteria of epiphysial union. The statements are based upon the same material from which the table of epiphysial union was compiled (20). In later communications this evidence will be amplified and more completely discussed.

TABLE 2

Female epiphysial union accelerated over male by months as below

AGE	
12–6 – 12–11	18 months
13–0 – 13–5	18
13–6 – 13–11	18
14–0 – 14–5	15
14–6 – 14–11	12
15–0 – 15–5	6
15–6 – 15–11	6
16–0 – 16–5	Less than standard deviation (3 months) and thereafter the same

The standard deviation to which reference is made in table 2 is that worked out by Hellman (9). This fully accords with our own observations. Once more the reader should be reminded that the crude statement of age in years, set down without fixation by date of birth, may mean anything from one day before the ensuing birthday to six months beyond the last preceding birthday, a total range of eighteen months. In our experience individual discrepancies between exact chronological age and skeletal age differing by not more than nine months can be set aside as fluctuations due to

minor causes. If however the discrepancy be twelve months or more some definite cause for the condition should be sought and will frequently be found. It may be a mistake in age record, some disease causing temporary or permanent retardation or, less often a general acceleration of development which may include mind as well as body.

In conclusion we may briefly survey the sex influence. Until the age of six years the sex differences are negligible apart from actual inception of ossification in secondary centers. From six to eight years the female forges ahead of the male and her acceleration reaches a maximum at about the latter date. There then ensues a slowing up in the female so that from the ninth to the tenth birthday the sexes are approximately equal in skeletal differentiation. After the tenth birthday the girls again undergo a period of acceleration which rapidly attains its maximum of two years and is failing when, after twelve and a half years, the criteria are changed through the introduction of a new feature, namely epiphysial union. From this date onwards the acceleration of female skeletal maturation over male diminishes until by the seventeenth birthday there is no sexual distinction which we have been able to prove to our satisfaction. In general therefore, and bearing in mind the reservations presented above, boys and girls may be said to punch the time-clock together.

THE RELATION OF RACE TO SKELETAL MATURATION

In considering the possible effect of so intangible an influence as race on skeletal differentiation it is necessary first to define what we intend by the term. Since the meaning may range from human stock to nationality we shall take one example from each of these extremes.

It has been possible to compare growth and maturation in white and American negro stocks and certain general results of our study may be briefly presented. Our negroes both male and female show much greater divergence than whites in the age-relationships of skeletal differentiation. This seems in some instances, it is true, to be an individual variability. Usually such children give a date of birth which, for a variety of reasons, we have been unable to check although others with definitely established birthdays do fluctuate a good deal in age-relationship. Most of these fluctuations however turn out on analysis to be impure. That is to say the age indicated by different skeletal areas is difficult to identify owing to obvious derangement of the area itself. Since these conflicting results trail out the age indications over a period of perhaps two or three years we term the children physical trailers. The impression one gets from studying the roentgenograms is that at some time in the child's history there has been a pathological repression of bony differentiation with definite defect in local areas. From this the child is now recovering but has not yet caught up in differentiation of certain areas to the standards for the chronological age. This is a very significant lead for further investigation. Our present feeling is that the differentiating skeleton is particularly vulnerable at certain stages of its

progress. It seems likely indeed that the most vulnerable stage is that of original precipitation of bone known as commencing ossification. Thus the date of first appearance of a bony center is delayed and when it does appear the developing center exhibits a wooly or sago-like appearance which has been described by numerous terms such as Köhler's disease, Schlatter's disease and Perthes' disease. The patella, navicular of the foot and carpal bones are particularly liable to show this condition. Eventually the bony area may recover and even catch up but frequently it remains deformed permanently. The condition may involve the shaft surface also. The most widespread and severe of such lesions is Chondrodystrophia or Achondroplasia in its various degrees. Usually the damage is much more local and erratic in site. Rickets undoubtedly is one of the factors to reckon with. The lesions affect the cartilaginous skeleton but may also involve the differentiating bone. More than this we need not say at the moment.

In analysing the negro records (77 boys; 72 girls) we found that a set of standards for male negroes illustrating the average development for each age period results in the establishment of an atlas of which the criteria of progress and of age-relationship are precisely those of the male white. White and negro boys, apart from pathological conditions punch the time-clock together: there is no genuine racial distinction. It is not quite so easy to explore the progress presented in the female series. Often indeed the negro girl is in advance even of the white girls. But it is only the relatively small number of our negro girls which leaves us still hesitant in assigning differentiation of negro girls to an age relationship identical with that of the white girls. So far however we have been unable to demonstrate positively any stock-linked differences. In this our results are identical with the conclusions published by Stevenson and with the observations made on suture closure in whites and American negroes (14).

Turning now to the other extreme, namely nationality, we have certain figures from a comparative study of American and Italian children. The criterion adopted to distinguish these series was the birthplace of the parents, the birthplace of the child himself being ignored in this investigation. If both parents were born in Italy (usually south Italy or Sicily) the child was entered as Italian. If both parents were born in America, the child is American despite the location of the child's birth. All children both of whose parents were not born in Italy or America were discarded.

In these sample series we had, of American born parents 101 boys, 100 girls: of Italian born parents 175 boys, 140 girls. The ages of the children range from five to thirteen years. The finished analysis gives us the information that American boys were twelve months advanced in height over the Italians, seven months in weight and four months in skeletal differentiation.

The American girls were fifteen months ahead of the Italians in height, eight months in weight and only two months in skeletal differentiation. These differences in height and weight show a feebly progressive character so

that the older children differed somewhat more than the younger. The fact that in skeletal differentiation the difference in girls was less than, and in boys scarcely more than the standard deviation indicates that there is no real distinction which can be laid to the charge of nationality.

Undoubtedly the Italians generally belong to smaller family lines than the Americans but possibly the differences in height and weight may be related to food, housing or other environmental conditions. The practical uniformity of skeletal differentiation bespeaks a uniform human pattern as do the results of our investigation of the negroes.

In skeletal development then we find no evidence of race-linked differences.

THE PROBLEM OF INDIVIDUAL DIFFERENCES AND CORRELATION WITH OTHER MEASURES OF DEVELOPMENT

The problem of individual differences, like the last topic, has two aspects. There may be inconsistencies in the child itself or the child as a unit may display a deviation from the average age-relationship. So far as the former is concerned there is nothing to be gained by further discussion at this stage. It has already been pointed out that very frequently inconsistencies of age relationship presented within the skeleton itself are due to pathological causes. One is inclined to suspect that individual divergences displayed by the child as a unit may also be due to anomalies of development. A warning has been issued against the assumption of "natural" variability which is extremely difficult to prove especially in the presence of numerous valid and tangible factors which can produce divergencies of pattern. In the period of adolescent lag, between thirteen and eighteen years, a series of fifty specially chosen lads in a health contest showed an average deviation of eight months from standard and fifty-two girls nine months from standard. There is no doubt that these candidates were selected upon widely differing standards ranging from physique to popularity and service. The incident illustrates the divergence rather than the uniformity of human material.

The most significant lead which we have struck in this phase of the problem is the fluctuation in height-weight-differentiation relationships. This has been touched upon in a previous paper but will bear further comment here. Other workers have had perforce to subdivide the children examined upon a quantitative basis and have often chosen percentiles for this purpose. The Baldwin-Wood tables for example classify the entire group, except for the highest and lowest 12.5 per cent, as medium. The remainder are designated tall and short respectively (2). This arrangement naturally and properly gives a wide range to the medium group. Upon our qualitative basis of skeletal differentiation a closer analysis can be made. A child whose skeletal record exceeds or lags behind the modal evaluation by more than nine months (three times the standard deviation) is classified as of accelerated or repressed development respectively no matter what his stature or weight.

In practice we classify as of average development all children who do not exhibit a full year's acceleration or

repression. This is just as much a fiction as the other method but it permits a fuller consideration of the features of bodily development in adding a third criterion to the height-weight-age standards.

TABLE 3

303 boys; 249 girls

Percentage groupings in skeletal differentiation

	ACCELERATED	AVERAGE	REPRESSED
Boys	9	60	31
Girls	30	48	22

Average skeletal differentiation

	HEIGHT AND WEIGHT			
	Large line	Heavy average	Average	Small line
Boys	33	3	37	27
Girls	24	6	42	28

Accelerated skeletal differentiation

	ACCELERATED HEIGHT UNDERWEIGHT	ACCELERATED HEIGHT OVERWEIGHT	ACCELERATED HEIGHT WEIGHT	AVERAGE HEIGHT WEIGHT	SMALL LINE
Boys	21	3	61	11	4
Girls	5	4	51	24	16

Repressed skeletal differentiation

	LARGE LINE	AVERAGE HEIGHT OVERWEIGHT	AVERAGE HEIGHT WEIGHT	REPRESSED HEIGHT WEIGHT	SMALL LINE
Boys	20	0	4	64	12
Girls	14	5	9	49	23

In a very tentative segregation of two series of boys and girls of grade school age numbering about three hundred boys and two hundred and fifty girls we find the following information (table 3).

In boys of average development there are 37 of average height and weight. There are 33 per cent of more and 27 of less than average height and weight. These are designated large and small lines respectively. There are but 3 per cent of average height but more than average weight. These are classed as of heavy line.

Among the girls there are 42 per cent of average height and weight, 24 of large and 28 of small line respectively. The heavy averages are 6 per cent. These figures, while purely provisional are in accord with general observation.

In the group of accelerated skeletal development we find, among the boys, 61 per cent also accelerated in height and weight, 11 per cent of average dimensions, and 4 of small line. As in the average development group there are 3 per cent of overweight among the accelerated lads, but there are 21 per cent of underweight.

The figures for the girls of accelerated development are somewhat different. Fifty-one per cent are also accelerated in height and weight, 24 are of average dimensions and sixteen are of small line. There are 4 per cent of overweights and 5 of underweights. These figures again are very suggestive and are worthy of much closer scrutiny than we can give them here. No matter how they may be changed in detail by fuller investigation or amplified series the broad generalizations remain. The fewer underweight girls, the more numerous large line boys, the proportions of small line

children of both sexes in average and accelerated skeletal development are all pretty much what one might have expected.

Coming to the repressed groups we find 64 per cent of the boys also repressed in height and weight, 12 per cent in addition are obviously of small line and only 4 per cent are of average dimensions. There are no overweights

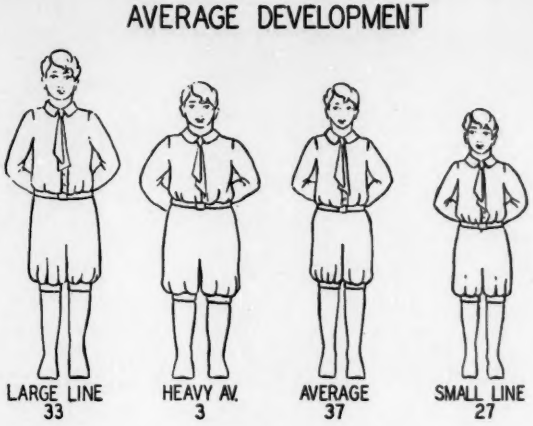

FIG. 1

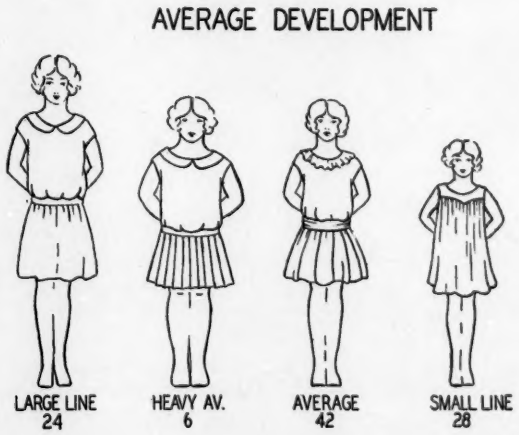

FIG. 2

FIGS. 1, 2. TENTATIVE PERCENTAGES OF VARIOUS BODILY FORMS IN WHITE BOYS AND GIRLS OF AVERAGE SKELETAL DIFFERENTIATION

but 20 per cent of the repressed group are of more than average height and while they look so big, they are really younger than their age.

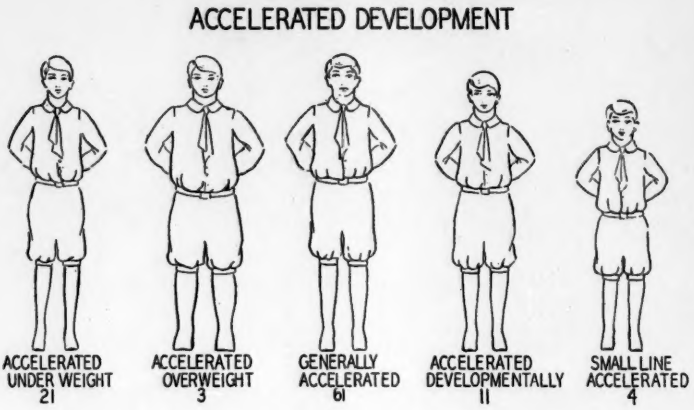

FIG. 3

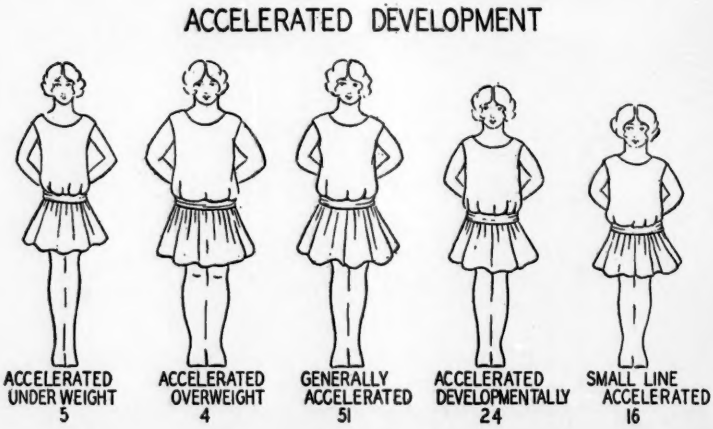

FIG. 4

FIGS. 3, 4. TENTATIVE PERCENTAGES OF BODILY FORMS IN WHITE BOYS AND GIRLS OF ADVANCED OR ACCELERATED SKELETAL DIFFERENTIATION

weight. These are repressed large line lads who have the most difficult time in meeting their environment because,

As for the repressed girls, 49 per cent were also of less than average height and weight and 23 per cent more were

distinctly of small line. There were 9 per cent of average dimensions and weight and 5 per cent of overweights.

pared with those of previous groups which is quite striking.

One further point must be made concerning this survey. The method of standardization, having nothing to do with height or weight, permits

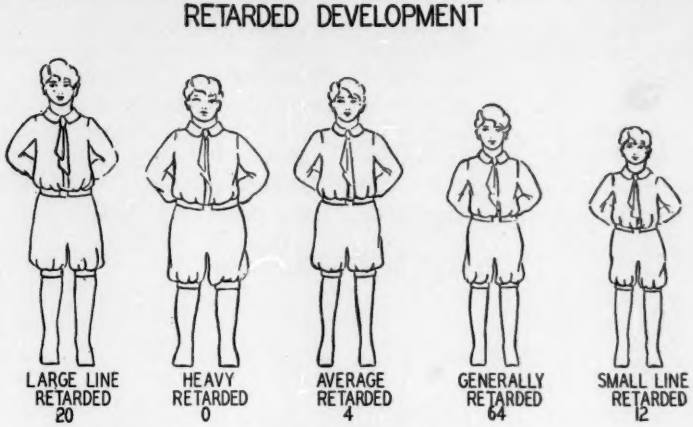

FIG. 5

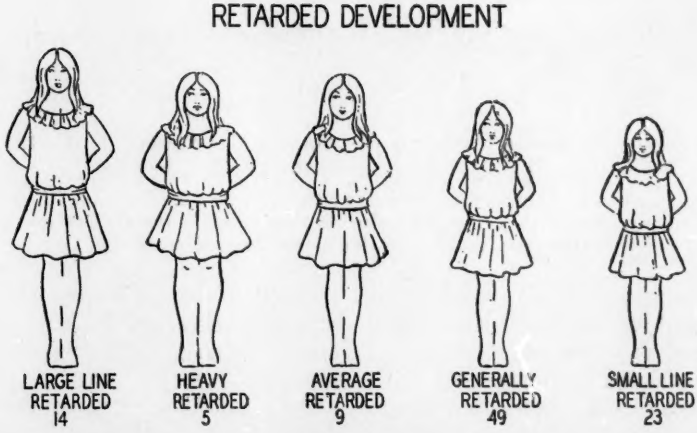

FIG. 6

FIGS. 5, 6. TENTATIVE PERCENTAGES OF BODILY FORMS IN WHITE BOYS AND GIRLS OF REPRESSED OR RETARDED SKELETAL DIFFERENTIATION

Finally 14 per cent were of large line. There is a harmony in the distribution of these figures when they are com-

a hitherto unattainable freedom in segregation. Among the boys 60 per cent are of average development, nine are advanced or accelerated and 31 are repressed or retarded.

For the girls the figures are: average development 48 per cent, accelerated 30 and represesd 22 per cent. The greater variability of the girls is characteristic. The numbers in the repressed groups, large though they are and requiring close study and vigorous attention, are not so great that we should have anything but a hopeful outlook for the future.

In summing up the discussion in this chapter we may conclude that individual variability does indeed occur and that it is greater in girls than in boys. There are more accelerated girls than repressed and more repressed boys than accelerated. Consequently in general, one may get the impression that girls are as a group further advanced over the boys than is actually the case. Details are presented in the second chapter of this paper. In all groups of children there will be large average and small family lines represented. In girls there is a closer relationship between dimensions and development than in boys. This is apparent from comparison of data in table 3.

In girls the average and heavy average physiques are together in exactly the same percentage as the average skeletal development. In boys however the average and heavy average physiques are 40 per cent of the total while the individuals of average skeletal differentiation form 60 per cent of their total. Hence we have among the boys a considerable group of pure large line. Whereas their height and weight are great their skeletal development is average. They correspond to giant races in animals. In girls those ac-

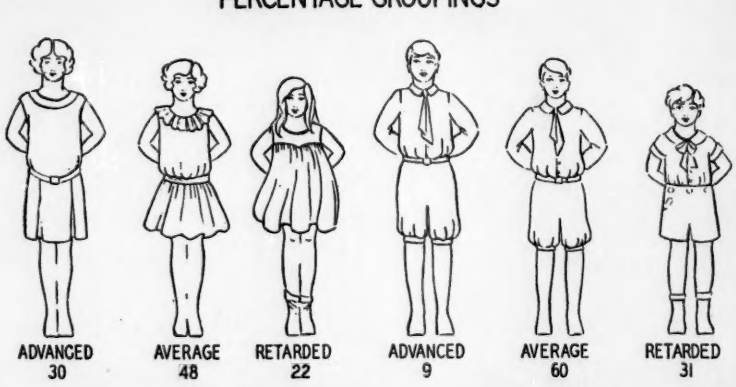

FIG. 7. PERCENTAGE GROUPINGS OF ADVANCED OR ACCELERATED, AVERAGE AND REPRESSED OR RETARDED SKELETAL DIFFERENTIATION IN WHITE BOYS AND GIRLS, EXPRESSED GRAPHICALLY IN PHYSICAL FORM AND FACIAL EXPRESSION

celerated in skeletal development are more numerous than those of large size. In them we have a greater number of small lines than of repressed skeletal development.

The purely provisional analysis to which the reader's attention has just been directed is reproduced as table 3.

LOCAL CONDITIONS OF LIFE

In the preceding chapter we have shown that the differences in skeletal differentiation and maturation demonstrable in any group of growing children are in large part brought about by pathological influences either in the present or past. The discrepancies which the negro children show from the white children of the same age are almost all of this type. In comparing Italian and American children we have given evidence to show that the differences are to be sought in physical form and size rather than in skeletal differentiation. It is our experience that children living under favorable home and other environmental conditions are larger than those in less fortunate circumstances. This is of course a truism. The financial status of the family has not necessarily any direct relation.

A child which is advanced in height and weight is also likely to be somewhat advanced in skeletal development especially in the knee, the differentiation of which seems more closely correlated to stature than hand or even elbow in spite of the close correlation (+0.797, see 17) in length of upper and lower limbs. Even in such fortunately placed children we do not often find the skeletal differentiation advanced more than nine months.

Again in unfavorably placed children we usually find that the repression of skeletal differentiation does not exceed nine months.

In a study of fifty undernourished children from the Cleveland Nutrition Clinic and the Fresh Air Camp we found no definite relation in the height-weight-skeletal-age records. Each of these children is a problem itself. Analysis will show exactly where the disharmony lies. Most frequently it is a disparity between height and weight rather than in skeletal differentiation.

Very undersized children may be the offspring of small family lines but there is an obscure condition which picks out one child only in a family. We have no light to offer on this problem at the moment but the observation that the knee will show greater repression than hand or elbow.

So far as can be seen at present it is unwise to postulate a "natural" variability. We ought to search far more closely into the history before we give a judgment of "natural" variation.

THE EFFECT OF DISEASE

The influence of disease upon skeletal differentiation may present itself in three definite forms.

1. Inhibition of differentiation

This may be complete as in certain hypophyseal disorders. It may however be temporary in character and the child gradually recovers. Such a condition is met with in rickets and we begin to suspect the exanthemata of affecting the skeleton in similar manner. The transverse lines or scars in the shaft of long bones recently de-

scribed by Harris (7) are instances of this condition.

In Chondrodystrophia or Achondroplasia also, lesser degrees of the disease bring about a partial inhibition with derangement of the growing areas. The hypophyseal disorders are the best illustrations of this type.

One of our examples is J. W., a man of 39 years, who at autopsy showed infantile genitalia, a glabrous skin, "feminine" contours and an osteoma in his hypophyseal fossa. The skeleton presents a condition of epiphysial union characteristic of twenty years. The diaphyso-epiphysial planes are themselves intact but their surfaces are markedly pathological. The billowing has given place to an exuberant granular overgrowth of cancellous bone which is quite characteristic of such lapsed union.

A. S. a man of 35 years with the mentality of a child of about thirteen presents the same external picture. Our roentgenograms show that skeletal differentiation was inhibited at the stage characteristic of fifteen years. So far we have found no roentgenographic evidence of anomaly or osteoma in the sella turcica.

2. Local manifestations of disorder

These are seen in a host of conditions often identified as chronic osteochondritis. Perthes' and Köhler's "diseases" are examples. The one best worked out is the lapsed union at upper end of humerus and femur which has been described in white rats by Dawson (3) whose excellent description of the histology of the affected areas (4) is applicable to many other conditions also.

3. More or less simple repression of skeletal differentiation from which the patient can recover under suitable treatment

This is best exemplified by hypothyroid cases where there is not, in the juvenile stages, any insuperable pathological development in the differentiating area.

As an example of this a case examined recently may be cited. The child was a girl aged nine years. The symptoms of cretinism were not very marked but our roentgenographic records of the skeleton show a differentiation equivalent to four years. There is nothing in the roentgenograms to indicate more than a very pronounced retardation. No positive inhibition at or deformity of the shaft ends or epiphyses can be discovered. With appropriate treatment there is hope of ultimate restoration, at least in part.

The same phenomenon presents itself in the series of sheep, thyroidectomized at one month of age, received by us through the kindness of the late Professor Sutherland Simpson and Doctor H. S. Liddell. Though the data upon this series have not yet been completely arranged for publication it is worth while to use as an illustration one sheep of five years which shows in its epiphysial maturation and union and also in its eruption of teeth the condition typical of a sheep of two years and a half. Examination of the diaphyso-epiphysial areas however shows quite clearly a minor grade of the same lesion as is found in lapsed epiphysial union from other causes.

It is of course not alone in cretins and hypothyroid cases that one meets with

such skeletal repressions. But these forms of disorder are very liable to develop with chronicity into examples of the first type. Such a border-line condition is illustrated by one of our negro girls of 7 years who shows a roentgenographic picture of scarred and deformed bones and epiphyses with an age equivalence of five years. Her stature, weight and muscular power are also at the five-year stage. The skeletal condition indicates healed rickets. The child has had a severe set-back from which she is now recovering and is progressing properly though still showing retardation with deformities which are permanent.

To conclude this section we may remark that pathological conditions may affect temporarily or permanently the progress of skeletal differentiation and that the lesion may be local or widespread. The skeletal picture as a rule however carries intrinsic evidence of the disorganization. The only exception, studied by us so far, is the cretin in his youthful stages before the long continued repression has become marked by definite pathological indications at the diaphyso-epiphysial planes.

SUMMARY

1. There is urgent need for a more comprehensive study of skeletal differentiation in its relation to sex, race, local conditions of life, individual variability, other measures of development and the devastations produced by disease.

2. Whether male or female the skeleton is essentially human and follows, in its development, a human pattern which is not obscured by sex modifications.

3. There is no necessary relationship between date of inception of ossification and date of epiphysial union. The undoubted earlier appearance in general of bony deposit in the cartilage of the female is not at all related to the ultimate progress of skeletal differentiation and epiphysial union.

4. The progress of skeletal differentiation presents patterns of relationship of female to male which are not uniform in the several areas of the skeleton roentgenographed. Between ten and twelve years there is a striking resemblance in the female-male relationship of the areas studied. After this the entire picture is changed by the appearance of epiphysial unions.

5. The progressive uniformity in general bodily development of boys and girls during infancy continues until six years. Skeletal differentiation is no exception, if one set aside the peculiar phenomenon of earliest ossific deposit the cause of which requires further elucidation. There then ensues a period of female acceleration reaching its maximum at about the eighth birthday and thereafter falling off so that between ninth and tenth birthdays the sexes are approximately equal in skeletal differentiation. After the tenth birthday a second period of female acceleration quickly reaches its maximum level and continues until twelve and a half years after which its diminution is measured by epiphysial union.

6. After twelve and a half years there is progressive diminution of female pre-eminence in skeletal maturation and by the seventeenth birthday when both boys and girls have reached their approximately full stat-

ure the sex differences even in epiphysial union disappear.

7. A critical study of the negro series shows these children far more liable than the whites to disorders which derange skeletal maturation. If however such examples are excluded we can find no clear evidence of a distinction in age relationship between whites and negroes.

8. Submitting a large series of children both of whose parents were born in America to close analysis of height, weight and skeletal development and checking against a similar series of children whose parents were both born in Italy, we find the Americans both taller and heavier than the Italians, age for age in six-month periods. We find no clear distinction in skeletal differentiation. From this and the previous findings we doubt very much whether there is any specific relationship of race to skeletal differentiation.

9. The age indications of the several skeletal areas in a single child may be moderately discordant. Although not frankly pathological these divergencies are usually the result of temporary disturbance in the growth pattern.

10. Just as children, by their dimensions, fall into large, medium and small family lines so they can be classified by skeletal differentiation into groups of accelerated, average and repressed development. The tentative figures submitted in this connection are worthy of careful thought.

11. Local conditions of living do affect the physical condition of the child but are reflected far more in such quantitative measurements as height and weight than in skeletal differentiation. Most instances of "natural" variation from the modal values can be assigned to definite causes and these should be sought with great care.

12. Pathological conditions may affect temporarily or permanently the progress of skeletal differentiation and the resultant lesion may be local or widespread. The skeletal picture as a rule however carries intrinsic evidence of the disorganization. The only exception, studied by us so far, is the cretin in his youthful stages before the long continued repression has become marked by definite pathological indications at the diaphyso-epiphysial planes.

REFERENCES

(1) BALDWIN, B. T., BUSBY, L. M., AND GARSIDE, H. V.: Anatomic growth of children. 1930 (Dated 1928), Univ. Iowa Studies, vol. 4, pp. 1–88.

(2) BALDWIN, B. T. AND WOOD, T. D.: Weight-height-age tables in English units. 1927, Iowa Child Welfare Research Station, State University of Iowa.

(3) DAWSON, A. B.: The age order of epiphyseal union in the long bones of the albino rat. 1925, Anat. Rec. vol. 31, pp. 1–17.

DAWSON, A. B.: Further studies on the epiphyses of the albino rat skeleton, with special reference to the vertebral column, ribs, sternum and girdles. 1927, Anat. Rec., vol. 34, pp. 351–363.

(4) DAWSON, A. B.: A histological study of the persisting cartilage plates in retarded or lapsed epiphyseal union in the albino rat. 1929, Anat. Rec., vol. 43, pp. 109–129.

(5) DODGE, C. T. J.: Weight of colored infants. Growth during the first

eighteen months. 1927, Amer. Jour. Phys. Anthropol., vol. 10, pp. 337–345. Weight of white infants. In Press.

(6) DWIGHT, T.: The skeleton. Piersol's Human Anatomy. 1911, (3rd edition) vol. 1, Philadelphia.

(7) HARRIS, H. A.: The growth of the long bones in childhood. 1926, Arch. Int. Med., vol. 38, pp. 785–806.

(8) HEJINIAN, L. M. AND HATT, E.: The stem-length: recumbent-length ratio as an index of body type in young children. 1929, Amer. Journ. Phys. Anthropol., vol. 13, pp. 287–305.

(9) HELLMAN, M.: Ossification of epiphysial cartilages in the hand. 1928, Amer. Journ. Phys. Anthropol., vol. 11,pp. 223–257.

(10) PRYOR, J. W.: Some observations on the ossification of the bones of the hand. 1916, Bull. Univ. Kentucky, vol. 8, pp. 1–67.

PRYOR, J. W.: Differences in the time of development of centres of ossification in the male and female skeleton. 1923, Anat. Rec., vol. 25, pp. 257–273.

PRYOR, J. W.: Time of ossification of the bones of the hand of the male and female and union of epiphyses with the diaphyses.1925, Amer. Journ. Phys. Anthropol., vol. 8, pp. 401–410.

PRYOR, J. W.: Difference in the ossification of the male and female skeleton. 1928, Journ. Anat., vol. 62, pp. 499–506.

(11) SAWTELL, R. O.: Studies in ossification and growth of children from one to eight years. 1929, Amer. Journ. Dis. Children, vol. 37, pp. 61–87.

SAWTELL, R. O.: Sex differences in the bone growth of young children. 1929, Amer. Journ. Phys. Anthropol., vol. 12, pp. 293–302.

(12) SCAMMON, R. E.: Recent work on the physical development of children. 1927, Second Conference Child Development, National Research Council, Washington.

(13) STEVENSON, P. H.: Age order of epiphyseal union in Man. 1924, Amer. Journ. Phys. Anthropol., vol. 7, pp. 53–93.

(14) TODD, T. W. AND LYON, D. W., JR.: Suture Closure. 1924–25, Amer. Journ. Phys. Anthropol., vol. 7, pp. 326–383; vol. 8, pp. 23–45; vol. 8, pp. 47–71; vol. 8, pp. 149–168.

(15) TODD, T. W.: The anatomy of growth. 1928, Northwest Medicine, vol. 27, pp. 165–169.

(16) TODD, T. W.: Types and indices of growth in childhood. 1929, Proc. 3rd Conference Child Development, National Research Council, Washington.

(17) TODD, T. W.: Punching the time-clock of age. 1930, Proc. Interstate Post-Graduate Medical Assembly, Detroit: pp. 236–239.

(18) TODD, T. W.: Comparative youth. 1930, Child Development, vol. 1, 2, pp. 79–89.

(19) TODD, T. W.: The anatomical features of epiphysial union. 1930, Child Development, vol. 1, 3, pp. 186–194.

(20) TODD, T. W.: The roentgenographic appraisement of skeletal differentiation. 1930, Child Development, vol. 1, 4, pp. 298–310.

A Study of the Art Ability Found in Very Young Children[1]

ALMA JORDAN KNAUBER

INTEREST in the problem of better training of creative tendencies of children led to the desire to investigate experimentally the nature of art ability in very young children.

The questions arising are:

1. How early art ability appears
2. What proportion of children show art ability
3. The subject matter of interest to young children
4. The effect of stimulation on their art work
5. The quality and quantity of drawing produced

This experiment was carried on in five grades: nursery, kindergarten, first, second, and third (ages two through eight). Schools were chosen where the children had never been given any formal art instruction. The number of children included in this experiment were: 33 nursery; 20 kindergarten; 51 first grade; 12 second grade; 9 third grade.

PROCEDURE

Paper (9 x 12 inch manilla) was supplied to these various grades for a period of five weeks. Each child had access to it so that he could draw when he felt inclined and time would permit. During this period the expression was quite free and unguided. All of the drawings made were collected weekly and tabulated. After this preliminary period the experiment was carried on from three to five weeks longer. Each class was visited once a week. An art program was given by the writer. The procedure was informal and the children gathered around to watch; there was no effort made to keep them interested.

The programs were as follows:

The first week the children were asked to suggest the things which they would like to have painted, and these were then sketched for them;

The next week the writer painted a portrait of two of the kindergarten children in colonial costume;

An exhibition of original but unframed paintings was shown the children the following week;

The fourth week the beauty of flowers and flower arrangement was explained and demonstrated and a painting of flowers was made before the class;

The last week the beauty of conventional commonplace life was portrayed, such as a nicely kept yard and house, boy mowing lawn, clothes on the line blowing in the wind, etc.

The aim of this period of stimulation and exposure to art was to encourage a natural desire for self-

[1] From the School of Household Administration, The University of Cincinnati, Cincinnati, Ohio.

expression by means of which they would show their ability, appreciation and interest. The drawings made by the children during this period were saved and the results tabulated. There was, then, a period of unguided expression followed by a period of stimulation. The questions to be answered concerning this experiment are:

How many drawings did these children make?
What subjects do they draw?
How well do small children draw?
What was the effect of the stimulation?

RESULTS

1. The number of drawings made by each child is shown in table 1. The medians for the various grades show that the older the child the more prolific he was. There was also great divergence in each age, as, in the first grade some did no drawing, and others made as many as 33. Differences as great as these must mean something although there is not always a close correlation between quantity and quality.

2. The type of subject drawn varied enormously, as is shown by the fact that the children drew a total of 148 subjects. There were 68 different subjects drawn in the nursery group; 32 in the kindergarten; 79 in the first grade; 47 in the second, and 54 in the third. It would take too long to present all the subjects drawn but table 2 shows the 78 subjects drawn more than once.

3. The next step was to find out how well the children drew. To obtain this information each drawing was rated from one to ten on the basis of its merit and an average was

TABLE 1

Number of drawings made by each child in the various groups

NUMBER	NURSERY	KINDERGARTEN	FIRST GRADE	SECOND GRADE	THIRD GRADE	TOTAL	TOTAL DRAWINGS
33			1			1	33
32							
31							
30							
29							
28							
27							
26							
25							
24							
23							
22							
21		1				1	21
20			2			2	40
19			1			1	19
18	1				2	3	54
17					1	1	17
16		1	1			2	32
15							
14			1			1	14
13		1				1	13
12			3		1	4	48
11			1			1	11
10	1	1	2			4	40
9	1	1	8	3	3	16	144
8	2	1	4	1		8	64
7	2	1	5	4	1	13	91
6	3	2	6			11	66
5	2	6	6	2		16	80
4	3	1	7		1	12	48
3	2	1	1	1		5	15
2	8	1	1			10	20
1	4	1		1		6	6
0	4	1	1			6	
Pupils Total...	33	20	51	12	9	125	909
Median .	3	5	7	7	9		

TABLE 2

Objects drawn listed in order of frequency

SUBJECTS	NUMBER OF TIMES DRAWN
1. grass	404†
2. sky	294†
3. house	243†
4. tree	226†
5. flower	179†
6. sun	114†
7. water	89†
8. tent	82†
9. boat	65
10. hill	64†
11. bird	47†
12. Indian	41
13. man	33†
14. rabbit	31
15. iris	27
16. flag	25†
17. path	23†
18. boy	21†
19. fire	18*
20. girl	15
21. table	15
22. bird house	14
23. airplane	13†
24. stage	13*
25. bowl	12
26. bridge	11
27. owl	11
28. window	11
29. fence	10
30. squirrel	10
31. canoe	9
32. elephant	9†
33. Goldilocks	9
34. moon	9†
35. horse	8
36. tulip	8
37. bear	7
38. fish	7
39. fish bowl	7*
40. peacock	7
41. smoke	7
42. wagon	7
43. chair	6
44. mill	6
45. rose arbor	6
46. auto	5
47. door	5
48. floor	5
49. picture	5
50. rain	5
51. rainbow	5
52. animals	4
53. duck	4
54. eggs	4*
55. swing	4
56. valley	4*
57. balloon	3
58. clock	3
59. clouds	3
60. holly hocks	3
61. lawn mower	3*
62. mountain	3
63. road	3
64. snow	3
65. wash	3
66. big fence	2*
67. car	2*
68. cat	2*
69. Christmas tree	2*
70. cupboard	2
71. dog	2
72. garage	2
73. letters	2*
74. parachute	2*
75. steamer	2*
76. station	2*
77. train	2*

* Drawn in only one grade.

† Drawn in at least 4 of the 5 grades.

computed for each child. The same standard presented below was used for each grade:

9–10 Excellent
7–8 Good
5–6 Average
3–4 Poor
0–1–2 Failure

Table 3 shows the distribution of the resulting "quality" scores. The me-

dian for the kindergarten and first grade appeared to be the same but the first grade has a greater proportion scoring high and also the upper scores are higher. The kindergarten and first grade were stimulated by practically the same material. Those making high enough scores on this arbitrary rating scale to suggest some talent are as follows:

TABLE 3

Showing average quality of work from each child

Drawings scored from 1 to 10, using same standard for each grade.

SCORE	NURSERY	KINDERGARTEN	FIRST GRADE	SECOND GRADE	THIRD GRADE
10					
9					1
8			1		
7			7	1	2
6		1	2	2	3
5		3	14	4	3
4		11	22	5	
3		2	5		
2	2	1			
1	5	1			
0	26	1			
Total....	33	20	51	12	9
Median..	0	4	4	5	6

Nursery, 2 children out of 33
Kindergarten, 1 child out of 20
First grade, 8 children out of 51
Second grade, 1 child out of 12
Third grade, 1 child out of 9

On the average one out of 13 children appears to have at least a little artistic talent. It is recognized that the drawings in the Nursery School and to a lesser degree in the Kindergarten suffer in comparison with older children when the same rating scale is used. It may be that the more inarticulate drawings at the early ages with imaginary titles assigned to them are more predictive of later creative ability than those more representative drawings that receive a higher score. The ratings have been given in order that we may make a comparison of what the children of these ages

TABLE 4

Subjects painted for Kindergarten, and influence upon their work

TOTAL SUBJECTS PAINTED FOR CLASS	NUMBER OF TIMES PAINTED	
	Before exposure	After exposure
1. acorn	0	0
2. background	0	0
3. birds	0	1
4. bowl of iris	0	3
5. flower arrangement*		
6. foreground	0	0
7. gold fish	0	0
8. grass	35	76
9. iris	0	3
10. leaves	0	0
11. portrait of boy and girl in colonial costume	0	0
12. rabbit	1	12
13. sea weed	0	0
14. showed water color paintings†		
15. shell	0	0
16. squirrel	0	4
17. tulip	0	3
18. turtle	0	0
19. tree	26	44

* No drawings returned after this lesson except one from each pupil made immediately at close of demonstration.

† Difficult to show influence statistically.

actually did in relation to standards that are assumed to be predictive of talent.

4. The last point of interest is the effect of the stimulation upon the subject matter chosen. The children added many new subjects during the week after these subjects had been drawn for them by the experimenter, although no effort was made to get them to draw these in preference to anything else. Table 4 shows a comparison of the number of times the subjects were drawn by the students before and after the experiment. The

TABLE 5

Comparison of number of subjects painted before and after stimulation

	NURSERY	KINDERGARTEN	FIRST GRADE	SECOND GRADE	THIRD GRADE
Before	45	17	31	21	25
New	22	15	48	26	30
Total	67	32	79	47	55

number of subjects drawn before were 17; the number of new subjects added were 15; total subjects painted were 32.

After one of the periods the Kindergarten teacher forgot and allowed the children to take their drawings home, which probably accounts for the lack of influence shown by some of the subjects. The tabulation shows a positive influence for 7 subjects. In the short period of exposure to art one can see by table 5 that the Nursery added 22 new subjects, the Kindergarten 15, the First Grade 48, the Second Grade 26, and the Third Grade added 30. These results indicate that stimulation does influence the children and leads one to suppose that desirable forms of stimulation might leave a molding and permanent effect upon development.

The lack of ability to represent the subject accurately apparently does not concern such young artists. In the kindergarten several unique subjects were drawn or attempted. The representation of abstract and unusual subjects is common, such as "The Sky Ladder," "Sparks All Over," "Sky Man," "Sky with Stars on Bottom of It," "Bug," "Faces," "Funny Old Cloud." Of the 72 subjects drawn only once, 39 were drawn by Nursery children. The decrease in subject matter by the Kindergarten (5 years) may be due to the growth of self-consciousness and shyness and unwillingness to be satisfied with the symbols of the younger child. Somewhere in the growth between 3 and 5 years of age children apparently discover "reality" and realize that sheer imagination will not compensate for poor technique. The First Grade child has apparently achieved more confidence in his ability to represent things. He also has learned patterns from the other members of his class or from instruction, since, for instance, boats were drawn 45 times in the First Grade. In the Second and Third grades the subject matter becomes more conventional, as compared with the Nursery children. They draw houses, trees, flowers, hills, Indians, tents, etc., but none of the highly imaginative subjects of the younger child.

SUMMARY AND CONCLUSIONS

As a result of the experiment one may summarize thus:

1. The proportion of those showing talent is not more than one in thirteen.

2. There is a great difference even in two year old children as to their interest and ability to draw.

3. The subject matter of interest to the nursery children touches all the things which are new and interesting to them without regard for pattern. In the Kindergarten, First, Second and Third grade they seem to be more interested in drawing the things for which they have learned the pattern. They are apt to draw their natural surroundings as sky, tree, house, boy, girl, etc., as listed. The other subjects are those which they learn by imitating others or by being exposed to them in some way.

4. Stimulation—The stimulation was very successful in creating an interest and in developing the child's talent along natural lines.

5. It can not be concluded that one might select those with talent at this early age until more time has elapsed in which to follow the development of these children. It is suggested, however, that proper stimulation toward creative activity would produce more and better trained artists and also a people versed in the appreciation of beauty.

Brief Reports

The Relation of Nursery School Training to the Development of Certain Personality Traits*

A GROUP of 22 nursery school children tested for personality traits over a period of six months were found to have developed certain personality traits to a much greater degree than a group of 21 children without nursery school training.

The two groups of children were comparable in age, intelligence, general physical development, and in their home background. The Taussig industrial classification was used to classify the parents. The Bonham-Sargent Scale was used for the children. In this scale scores were obtained for the list of traits included in this test. It was found that the nursery school children became less inhibited, more spontaneous, and more socialized with training. They developed more initiative, independence, self-assertion, and self-reliance than the control group. They showed a greater increase of curiosity and interest in their environment. As might be expected, their habits of health and order were much more numerous than in the control group.

* An investigation made at the Washington Child Research Center (as graduate work for the Catholic University of America).

The superiority of the personality traits of the nursery school children over children who did not have systematic training, as shown by the statistical validity of the scores, was probably due to a great extent to the influence of the social force of a large group of children who had to adjust to each other constantly.

Average differences of the rating of personality traits of an experimental group of 22 children and a control group of 21 children as shown on the first and second Bonham-Sargent Questionnaires

(The total number of traits is much larger than the sample given here)

	EXPERIMENTAL	CONTROL
Initiative:		
Does he wait to be told what to do next?	−.900	+.425
Good nature:		
Is he cheerful when toys are taken away?	+.022	−.476
Curiosity:		
Does he ask questions demanding explanations?	+1.940	+1.690
Does he try to open examiners' package?	+.840	−.150
Does he try to find out how mechanical toys operate?	+1.636	+.047
Contentment:		
Does he play quietly with toys given him?	+.954	+.380

	EXPERIMENTAL	CONTROL
Pride:		
Does he demand praise in achievement?	−.136	+.761
Orderliness:		
Can he arrange toys in an orderly way?	+1.476	+.095
Sympathy:		
Does he show sympathy when stranger feigns weeping?	+1.289	+.047
Initiative:		
Does he climb for objects?	+.718	+.225
Habit formation:		
Has he bladder control?	+.676	+.250
Has he bowel control?	+.361	+.166
Can he feed himself?	+.529	+.300
Does he eat what is set before him?	+.718	−.025
Obedience:		
Is he obedient to parents?	+.277	+.300
Responsibleness:		
Has he a tendency to argue?	+.687	+.210
Fear:		
Is he easily frightened?	−.142	+.475
Affectionate:		
Is he affectionate?	+.055	+.105
Politeness:		
Does he say "please" and "thank you"?	−.033	+.275
Sociability and shyness:		
Does child approach other children readily?	+.684	+.550
Is he cordial to strangers?	+.368	+.263
Treatment of others:		
Is he considerate of younger children?	+.285	+.125
Miscellaneous:		
Does he exhibit responsibility for their safety?	+.333	+.076
Does he show respect for the property of others?	+.368	+.157
Does he put his toys away?	+.473	+.210
Does he keep his clothes in good condition?	+.368	+.210
Suggestibility and independence:		
Does he insist on his rights?	+.650	+.421
Does he resent interference?	+.250	+.187
Good nature:		
Is he afraid of animals?	−.100	+.050
Is he afraid of lightning?	.000	+.066
Is he afraid of darkness?	.000	+.050
Generosity:		
Will he share his favorite toys?	+.333	+.277
Will he divide a tempting delicacy with others?	+.150	.000
Pride:		
Does he react strongly to blame?	+.300	+.222
Does he react strongly to praise?	+.277	+.300
Concentration or (contentment):		
Does he turn from one activity to another?	−.352	−.052
Play habits:		
Is he self-dependent in play?	+.500	+.150
Is he noisy in play?	+.058	−.210

It can be seen that the generally accepted desirable personality traits increased in the experimental group and the less desirable traits increased in the control group.

MARY ELIZABETH WALSH.

Changes in Egocentricity of Nursery School Children

THE study was made to find the differences in the egocentric behavior of young children and the way the behavior changes in a new social situation. The overt behavior which showed the egocentricity of the children and the modifications were studied. Observations were made of the children during their free play activity. Egocentricity was defined as the attempt of a child to make himself the center of an activity.

It was found that a child expresses his egocentric behavior in three ways; by the type of play—alone or with others—by his methods of retaining toys which another child wants and by his methods of gaining attention from other children and from adults. The information was obtained by a quantitative record of the distribution of play activities. The records were kept for successive days of the children's first three months in the nursery

TABLE 1

Proportion of total time spent in various ways while at free play during different periods

CHILD	LENGTH OF TIME AFTER ENTERING SCHOOL	PLAY ALONE	PLAY WITH OTHER CHILDREN	WATCHING OR SITTING QUIETLY	WANDERING AIMLESSLY	"SOCIALIZING"
		per cent	*per cent*	*per cent*	*per cent*	
A	5 weeks	51.7± 5.3	35.0± 4.9	1 ± .7	9.3 ±6.7	3 ±2.0
	9 weeks	62.5± 0.4	33.5± 3.0	1 ± .7	3.0 ±2.0	0 ± ?
	11 weeks	66.7± 5.2	17.0± 8.1	1 ± .7	12.7 ±1.2	3 ±2.0
	Change between 5th week and 11th week	+15.0± 3.6	−18.0± 5.9	0 ± .4	+3.0 ±3.5	0 ±1.8
B	5 weeks	64.0± 6.2	10.3± 5.5	16.7± 9.9	4.7 ±0.3	5.0 ±1.0
	9 weeks	35.5± 8.9	20.5±13.8	2.5± 1.7	10.5 ±7.1	31.0 ±3.4
	11 weeks	60.7±10.1	36.7± 5.0	0 ± ?	0 ± ?	2.7 ±1.8
	Change between 5th week and 11th week	−3.3±10.1	+26.4± 5.0	−16.7± 6.3	−4.7 ±0.2	−2.3 ±1.3
C	5 weeks	16.7± 7.7	46.7±14.8	10.7± 7.2	16.7 ±3.3	10.7 ±4.6
	9 weeks	18.5± 3.7	54.5± 0.3	1.5± 1.0	8.5 ±0.3	17.5 ±3.7
	11 weeks	22.3± 9.1	35.0± 8.8	17.3± 5.1	13.75±3.5	11.75±4.6
	Change between 5th week and 11th week	+5.6± 8.2	−11.7±10.6	+6.5± 5.5	−3.0 ±3.1	+1.0 ±4.4
D	5 weeks	41.3±18.8	0 ± ?	47.0±19.6	7.0 ±2.7	0 ± ?
	9 weeks	12.5± 2.4	24.0±11.5	31.5±16.6	21.5 ±9.6	9.5 ±6.4
	11 weeks	20.0± 8.6	48.0±11.2	16.0± 6.0	8.0 ±5.4	8.0 ±2.9
	Change between 5th week and 11th week	−21.3±11.2	+48.0± 7.8	−31.0±10.7	+1.0 ±4.0	+8.0 ±2.0

school. Quantitative frequency records were kept also of the attempts to prevent another child from taking a toy, of the amount of time spent voluntarily near adults, of aggression towards other children, of the amount of crying and the number of temper tantrums.

It was found that those children who were dominantly egocentric on entrance into a new social situation make few significant changes during the first three months, but the unaggressive children become more egocentric in their play, changing from the unaggressive to the aggressive. A positive correlation was obtained between the age of the child on entering a new social situation and the type of egocentricity.

L. F. Ezekiel.

The Space Order Reaction of Young Children

TWO tests devised by Schachne Isaacs for the study of the development of the space order reaction required in reading were given to 23 children in the Child Institute of The Johns Hopkins University. The ages ranged from two and one-half to five and one-half years.

POINTING AT PICTURES

Two sets of sixteen colored pictures, of varying degrees of interest, familiarity, and attractiveness, were mounted in rows of four on charts, 20 x 20 inches, ruled off in 5 inch squares. These were presented to the child who was given a yard stick and asked to point to and name as quickly as he could all the pictures on the chart. The examiner recorded on a prepared form the order of naming, noting repetitions and omissions.

In the first set of pictures one child used the reading order in pointing, one used another regular order, and 21 used no regular order. In the second set the same child used the reading order as she did in the first set, and two used another regular order. Twenty used no regular order.

CHECKING CIRCLES

The child was asked to put a check in each circle of a set of 16 half-inch circles, ½ inch apart, in rows of four. A similar record of order of checking, repetitions and omissions, was made.

In this test none used the reading order, two used other orderly methods, and seven gave a semi-orderly response, that is, twelve or more of the checks were arranged in an orderly manner. Fourteen used no regular order.

For speed and accuracy the most effective response is to begin in one of the four corners and name or check across rows or up and down columns. A number of adults tested gave without exception the reading order of response.

These results indicate that the reading space order from left to right which is used by adults in responses to the situations of the test procedure is determined by training in reading.

Roberta White.

Influence of Suggestibility on Responses in Ink Spot Test

SUBJECTS of this experiment were 16 children, 11 boys and 5 girls, from the Child Institute of Johns Hopkins. Their age was recorded to the nearest month and mental age computed from the I.Q.:

	Median	*Range*
C.A.	53 mo.	65–41 mo.
M.A.	58.5 mo.	89–45 mo.
I.Q.	114.5 mo.	83–137

Materials consisted of ink spot plates number 1 to 10 from Whipple's series.

PROCEDURE

Series A

After the child was seated at a small table the experimenter said, "I am going to show you a funny shaped spot." The first plate was placed on the table in front of the child with the directions, "You tell me what it looks like." A stop watch was used to record the time from exposure of the picture to the first response. If the child said that the picture did not look like anything he was urged to "just pretend" what it looked like.

Series B

This was given a week or two after series A. Procedure was identical except that when the ink spot was shown, in addition to saying, "Tell me what it looks like," the question was added, "Is it a girl?" for spot 1 "Is it a policeman?" for spot 2, etc. The words suggested for the various spots were as follows:

1. girl
2. policeman
3. hat
4. flower
5. elephant
6. doctor
7. rabbit
8. table
9. squirrel
10. snake

RESULTS

The time of reaction was not significant. It was slightly less on the average for series B where suggestion was given, but the difference was very small.

A. The responses were tabulated for each ink spot separately. Those used most often were:

Spot
1. man (4 times) horse (2 times)
2. lady (7) man (3) woman (2)
3. dog (10)
4. house (2)
5. dog (3)
6. lady (4) king (2) house (2)
7. lady (4)
8. chair (2) man (2)
9. chair (2) foot (2)
10. tree (3) bear (2) man (2)

In all 73 different responses were made, with a total of 168 when repetitions were counted. Of this total 43 per cent were names of animals, 30 per cent of people, and 27 per cent of objects. In choosing the names which were suggested in series B, this proportion was adhered to. Four names of animals were used, three of people, and three of objects. Five of these names had appeared once in the children's responses of series A, five not at all. In no case was a name suggested in connection with the spot to which it had been applied in series A.

Series B was scored on the bases of the number of suggestions which were

accepted. Acceptance meant saying "Yes" or repeating the name suggested. If a child said "No," but then named the spot in accordance with the suggestion given, this was scored acceptance. If he said "Yes," but then gave some other name, it was scored rejection of the suggestion.

The acceptance score ranged from 0 to 9 with an average of 3.3.

Two of the children applied the same name to several of the spots. The youngest child used only three different names for the ten ink spots, the oldest used nine, and two used ten. The average number of different names used was 7.9.

A record was also made of the number of times each child called a spot by the same name in series B which he had applied to it in series A. This number ranged from 0 to 8 with an average of 2.5.

REVISED PROCEDURE

The change in procedure involved the giving of a suggestion with the first instead of the second series, a change in some of the suggestion words, and the use of a better presentation of the spots.

The subjects of this experiment were 20 children, 13 boys and 7 girls attending the Nursery School of the University of Minnesota. Their age was recorded to the nearest month at the time of commencing the experiment. The I. Q. was taken from a test given previously, the Kuhlman-Binet in the case of 12 children, Minnesota Test in the case of 8. Mental Age was calculated from the I. Q. to the nearest month.

	Median	*Range*
C.A.	47 mo.	37–60 mo.
M.A.	50 mo.	31–79 mo.
I.Q.	108.5 mo.	83–152

Apparatus consisted of the first ten ink spot plates of Whipple's series of twenty, and a simple exposure frame. This was a large envelope of black paper with an opening 2½ inches square through which the plates were shown. Two small chairs and a low table to which the frame was tacked completed the set-up.

Series A

The experimenter and the child both seated themselves at the table. The envelope was lying before the child with plain black paper showing through the aperture. Light came from above and to the left of the child. When the child was at ease his attention was directed to the envelope and then the first plate was exposed. The question was asked: "What does this look like, a girl?" If the child did not respond he was encouraged by the words, "What?" or, "Tell me what it looks like." After the child's response had been recorded the first spot was removed, exposing the second. The above procedure was repeated except that a different object was suggested as a name for the ink spot. The objects suggested for the 10 spots were:

1. girl
2. dog
3. bird
4. engine
5. engine
6. tree
7. rabbit
8. table
9. squirrel
10. boat

Series B

The materials and procedure were identical with those used in series A

except that the suggestion was omitted. When a picture was exposed the child was asked, "What does this look like?" After the child's response assent or approval was shown by saying, "Yes," or repeating the word the child had given so as to make sure of it.

Series B was given approximately three weeks after series A. With nine of the children the interval was 20 days, with seven, 21 days, with two, 22 days, with one, 24 days, and with one, 26 days. All of the tests of this experiment were given between the hours of 10:00 and 12:00 a.m.

Results

The children reacted to the test situation in a variety of ways. Some seemed very anxious to please, accepting the suggestion given by the experimenter because they thought they were supposed to do so. Others paid scarcely any attention to what the experimenter said, brushing aside the names offered and enjoying the task of using their own imaginations. A few were not interested in the task and accepted the suggestions because that was the easiest and quickest way to get through. One boy insisted on manipulating the pictures himself, removing each after he had named it. The test seems to be at fault in its lack of opportunity for the child to *do* anything.

In three cases a child failed to accept a suggestion merely because he had already named the spot before time was given for the suggestion. This time element is important and should be more carefully controlled.

In series B the most obliging children had a tendency to repeat one name after the experimenter had approved it, applying it to several succeeding ink spots. A few of the older children recognized the ink spots as what they had seen in Series A but the majority made no such comment.

Tabulation of the various types of reaction gave the following figures:

Series A

	Spots
Suggestion accepted for	116
Suggestion first accepted then rejected for	8
Suggestion first rejected then accepted for	3
Delayed acceptance of suggestion for	10

This last includes those cases where the suggested name was rejected, but then applied to the next ink spot. The first category alone contains enough cases to make scoring possible and this was adopted as the score measuring receptivity for suggestion. It ranged from 10 in four cases to 0 in two. The average score was 5.8.

Series B

	Spots
Suggestions given in series A retained for	13
Names applied in series A repeated for	41
Name applied which was both a repetition of the suggestion and a repetition of the name used in series A	8

The fact that 116 out of a possible 200 suggestions were accepted seems to indicate that it was easier for a child to accept than to reject suggestions under the test conditions. Delayed acceptance of suggestion appeared definitely in only four cases. The other six cases are made up of

those who called spot 3 a "dog." Since this spot in reality closely resembles a pup, that fact rather than the suggested name dog for the previous spot probably caused the delayed suggestion.

In series B there were 41 cases where a child repeated the same name which he had given to a spot previously. Of these only 8 were names suggested by the experimenter. Memory for suggested names is thus much poorer than memory for those names which the child applied to a spot himself.

Those children who accepted the most suggestions in series A seem to accept no more than the average in series B. The children were divided into two groups according to their score in series A. The sum of the scores of the ten highest was 87, of the ten lowest 29. Yet in series B the upper ten accepted only 6 suggestions, while the lower accepted 7.

Though there appears to be no correlation between acceptance of suggestions in series A and using that suggestion again in series B, there is a significant negative correlation between receptivity score (series A) and repeating in series B the name used in series A. By the rank order method the coefficient of correlation was $-.57$ with a P.E. of .11. This may be explained by the fact that memory is related to general intelligence which in turn seems to have a negative correlation with suggestibility or receptivity. The coefficient correlating I.Q. and receptivity score is $-.40$, P.E. .13. Score correlates slightly lower with C.A., $-.37$, P.E. .13, and highest with M.A., $-.47$, P.E. .11. This is in agreement with other investigations which find suggestibility correlated inversely with intelligence.

ROBERTA WHITE.